IEEE-CYBER

Jiaxing, China July 27-31, 2021

The 11th IEEE International Conference on

CYBER Technology

in Automation Control and Intelligent Systems

PROGRAM

IEEE

IEEE Robotics & Automation Society

The 11th IEEE International Conference

on CYBER Technology

in Automation, Control, and Intelligent Systems

IEEE-CYBER 2021

Conference Digest

Jiaxing, China

July 27-31, 2021

IEEE-CYBER 2021 PROCEEDINGS

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The Institute of Electrical and Electronics Engineers, Inc.

Welcome Message

Welcome to the 11th Annual IEEE International Conference on ***CYBER*** Technology in Automation, Control, and Intelligent Systems. The IEEE-CYBER is a key international conference, financially sponsored by IEEE Robotics & Automation Society, the Shenyang Institute of Automation CAS, and the Shenzhen Academy of Robotics, 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 July 27 to 31, at the Ramada Hotel, Jiaxing China, with the spirit of bring together researchers and engineers from around the world to present their latest research findings, accomplishments, innovations, and visions in the related fields.

With 247 paper submissions from 7 countries or regions, 169 papers have been selected for presentation at the conference after going through a rigorous review process. The technical program of the IEEE-CYBER 2021 consists of 3 plenary talks, 4 keynote talks, 20 technical sessions organized into three parallel tracks, and 4 separate poster sessions. The goal of IEEE-CYBER 2021 is to create an opportunity for participants to present their latest research results to an 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 IEEE- CYBER 2021, including welcome reception, banquet, and farewell reception. We hope IEEE-CYBER 2021 will be a valuable, memorable and exciting platform for all of you to exchange ideas and information, identify new research interests, establish collaborations, make friends, and find new opportunities for your career.

IEEE-CYBER 2021 will give out three technical awards: *Best Conference Paper Award*, *Best Student Paper Award*, and *Best Poster 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 greatly appreciate the Shenyang Institute of Automation, Shenzhen Academy of Robotics, and the Southeastern University for their strong support to the organization of this conference. In addition, 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 2021 would not have been possible without your commitment and efforts. We would also like to thank all the people who have helped and supported this conference in one way or another, especially Ms. Jiaying Qian (Shenzhen Academy of Robotics) for her tireless efforts in making the conference organization matters seem effort-less. 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 2021 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 Jiaxing.

Finally, we wish you a wonderful and joyful stay in Jiaxing, China!

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Heping Chen
Texas State University
USA

Program Chair
Xingang Zhao
Shenyang Institute of Automation
China

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CYBER 2021 Sponsors

We acknowledge the support of the following Sponsors to the 11th IEEE International Conference on CYBER Technology in Automation, Control, and Intelligent Systems (IEEE-CYBER 2021).

General Information

Ramada Jiaxing Hotel

Address: No. 32 Qinyi Road, Jiaxing, Zhejiang, China, 314050

Registration Desk at Lobby, Ramada Jiaxing Hotel

Date		Time	Venue
July 27	Tue	14:00-18:00	Lobby, Ramada Jiaxing Hotel
July 28	Wed	08:50-17:00	Lobby, Ramada Jiaxing Hotel
July 29	Thu	09:00-17:30	Lobby, Ramada Jiaxing Hotel
July 30	Fri	09:00-15:00	Lobby, Ramada Jiaxing Hotel

Conference Events:

Welcome Reception on July 27

18:00-20:00 at Ruby Western Restaurant, 3/F

Conference Banquet and Award Presentation on July 29

18:00 at Ramada Grand Ballroom B, 5/F

Farewell Reception on July 30

15:00-17:00 at Ramada Grand Ballroom B, 5/F

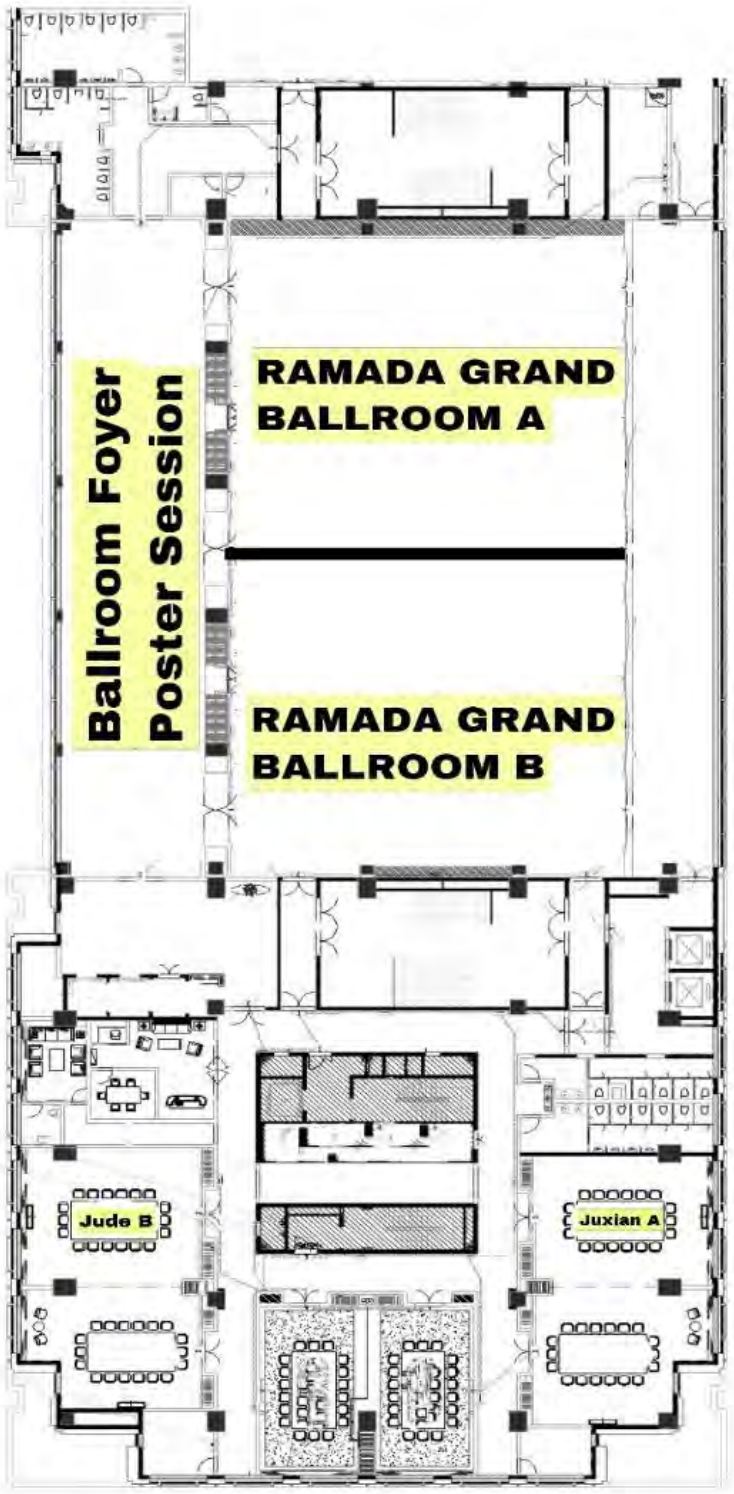
Lunch on July 28-30

12:30 -13:30 at Ruby Western Restaurant, 3/F

For the conference banquet, all registered participants are free. However, additional banquet tickets for their guest should be purchased at the registration desk.

Floor Map- Ramada Jiaxing Hotel

5F-(Plenary Talks, Keynote Talks, Oral Sessions, Poster Sessions, Coffee Breaks and Conference Banquet)



Official Language

The official language of the conference is English.

All presentation including discussion and submissions shall be made in English.

Presentation Specifications

In each oral presentation room, one computer and one LCD projector will be available. The presenters could also 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 are listed below:

- **Plenary Talks** are scheduled for 1 hour (including 5 min Q&A) each.
- **Keynote Speeches** are schedule for 40 minutes (including 5 mins Q&A) each.
- **Regular Sessions** are schedule for 15 minutes (including 3 mins Q&A) each.

Poster Specifications

Dimensions: 35.4 inches (90 cm) wide x 47.2 inches (120 cm) high.

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.

Conference Attire

Appropriate attire is requested during the conference; e.g., casual attire at the Welcome and Farewell Receptions; smart causal for all technical sessions, and at the Banquet.

Access to Ramada Jiaxing Hotel

–The hotel is 10-minute drive from Jiaxing Train Station

- The hotel is 36-minute drive from The Ancient Town of Xitang

Conference Awards

Best Conference Paper Award

Any paper with original research results can be considered for the Best Conference Paper Award, provided that the research results presented have not been presented anywhere else in the world at the time of paper submission.

Best Student Paper Award

Any original research work can be considered for the Best Student Paper Award, provided that the first author is a student and primary developer of the ideas contained in the paper.

Best Poster Award

Any paper with original research results presented at poster session can be considered for the Best Poster Paper Award, provided that the research results presented have not been presented anywhere else in the world at the time of paper submission.

About Jiaxing

Jiaxing has been a prosperous and prosperous place since ancient times, known as the "land of fish and rice", "the silk house" reputation, is the country's historical and cultural city, China's civilized city, the whole of China double-support model city, China's green model city, China's outstanding tourist city and national garden city. Jiaxing has also attracted worldwide attention for the successful closing of the first National Congress.

Wuzhen

Wuzhen is one of the first batch of Chinese historical and cultural towns, China's top ten charming towns, the country's beautiful environment townships, the country's 5A-class tourist attractions, known as "China's last pillow water family" reputation, with more than 7000 years of civilization history and 1300 years of town history, is a typical Of china Jiangnan Water Town, there is "the town of fish and rice, silk capital" said. Early in the morning, the night of the west gate, the most beautiful town of Wuzhen.

Some people say that the gentlest side of Wuzhen is the morning in the east gate, the street smoke hazy, everything in the distance is only a faint shadow.

Qiantang River

Every year on August 18th, the Qiantang River tide is the wonder of the world, every day, the tide of people and people, the tide is like the tide. The tide peak is as high as 3-5 meters, the back waves catch up with the front waves, layer by layer, like a long white belt, and there is a trend of mountains falling to the sea. Poem cloud: "Chantang a look at the waves, an instant wild wave across the eyes; Seems to be ordinary river water, the energy can be amazing." The tide head from far and near, galloping, the tide head pushing, sounding like thunder, spraying beads splashing jade, like a million horses Pentium.

Xitang

Xitang was one of the first chinese historical and cultural towns and has been listed by UNESCO as a reserve for the protection of China's World Cultural Heritage. The old town area has a well-preserved 250,000 square meters Ming and Qing building complex, the scale and preservation of good is rare in Jiangnan. Spring and autumn water, Tang and Song town, Ming and Qing architecture, modern people, unique Xitang.

Plenary Talks

Plenary Talk 1: Wednesday, July 28, 2021 09:00-10:00
Session Chair: Heping Chen, Texas State University

Power Inspection Teleoperation Robot Technology in Complex Environment

Aiguo Song

Professor
Robot Sensor and Control Laboratory
School of Instrument Science and Engineering
Southeast University, China

Abstract:
This report firstly introduces the background and importance of the power inspection teleoperation robot technology. Then the challenges of the inspection robot are put forward, and the key technologies are briefly discussed. The research work carried out by the Robot Sensor and Control Lab of Southeast University for the power inspection teleoperation robot in complex environment is reported. The research progresses and developments in our lab are introduced. Finally, the applications of the inspection teleoperation robots in different complex environments are reported, which based on the collaboration with some companies.

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, rehabilitation robot, and power inspection robot. He has published more than 300 peer reviewed journal papers, and 200+ papers have been indexed by SCIE, and SCI cited time is 2500+. He received the best paper awards 13 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.

Plenary Talk 2: Thursday, July 29, 2021 09:00-10:00
Session Chair: Xingang Zhao, Shenyang Institute of Automation, Chinese Academy of Science

Computational Approaches for Guiding Rational Vaccine Design: Case Studies of HIV, HCV and COVID-19

Matthew McKay

Professor
Departments of Electronic and Computer Engineering and Chemical and Biological Engineering
Hong Kong University of Science and Technology, China

Abstract:
This talk will describe how computational modelling and high-dimensional statistics can aid the rational design of vaccines. Approaches familiar in signal processing and physics will be introduced and applied to genetic sequence data of viruses measured from infected individuals. It will be described how such approaches can be used to build computational models that inform how viral fitness is mediated by correlated sets of genetic mutations, and to simulate viral evolutionary dynamics in individuals who present specific immune responses. When combined with experimental and clinical data, the talk will describe how the models may be used to rationally design new vaccine candidates for HIV and the hepatitis C virus (HCV). Recent progress on the impact of data analysis on vaccine development for COVID-19 and in guiding experiments to understand human immune responses against COVID-19 will also be discussed. Overall, this talk with highlight the important role that data analysis and computational methods can play in modern and future vaccine development.

Biography:
Matthew McKay is a Professor of Electronic and Computer Engineering and Chemical and Biological Engineering at the Hong Kong University of Science and Technology (HKUST); previously holding the Hari Harilela Chair. He received his PhD from the University of Sydney in 2007. Matthew has held visiting positions at MIT's Institute for Medical Engineering & Science and Stanford's Statistics Department. His research interests fall at the intersection of disciplines, and include information and communication technologies, statistics and machine learning, and computational immunology. He has been selected as a Young Scientist of the World Economic Forum, a Young Scientist of the World Laureates Forum, and is a Fellow of the IEEE.
Matthew and his co-authors have received multiple paper awards, including the Stephen O. Rice Prize by the IEEE Communication Society and a Young Author Best Paper Award by the IEEE Signal Processing Society. He received the Young Investigator Research Excellence Award by the School of Engineering at HKUST, and the Best Young Researcher Award (Asia Pacific Region) by the IEEE Communication Society. He has served as Area Editor for the IEEE Signal Processing Magazine, and on the editorial boards of the IEEE Transactions on Wireless Communications and the mathematics journal, Random Matrices: Theory and Applications.

Plenary Talk 3: Friday, July 30, 2021 09:00-10:00
Session Chair: Lianqing Liu, Shenyang Institute of Automation, Chinese Academy of Science

Wireless Networks for Industrial Automation: From WIA to 5G

Haibin Yu

Professor
Shenyang Institute of Automation, CAS, China

Abstract:
The continuous technology innovation on information and communication technology (ICT) drives cyber-physical fusion and motivates new industrial revolution. Industrial wireless network (IWN) is a representatively outstanding technology that helps integrate ICT with operation technology (OT). During the past decades, academia and industry have invested great efforts in developing IWN, such as WirelessHART, ISA100.11a and Wireless Networks for Industrial Automation (WIA). More recently, ITU and 3GPP also propose to develop ultra-reliable low delay communication (URLLC) for industrial automation.
This talk first introduces the fundamental communication requirements of industrial automation and discusses the challenges in developing IWNs. Then, a typical IWN technology family called WIA is introduced in detail including the system architectures, protocol stacks, applications and performances. Finally, the evaluation of WIA towards 5G is discussed and the future IWN is envisaged.

Biography:
Haibin Yu, Professor and Director of Shenyang Institute of Automation, Chinese Academy of Sciences, China. He serves as the Vice-Chair of Chinese Association of Automation, the Chair of China National Technical Committee for Industrial Process Measurement Control and Automation Standardization. He has published two books, authored or co-authored more than 200 papers, and held more than 50 patents. He and his research team developed the WIA-PA and WIA-FA standards specified as IEC 62601 and IEC 62948, respectively. He was elected as an ISA Fellow for his contributions in fieldbus technologies in 2011. He also serves as the Editor-in-Chief of Robotic and the Associate Editor-in-Chief of Information and Control. His research interests include industrial communication and networked control, industrial automation and intelligent manufacturing.

Keynote Talks

Keynote Talk 1: Wednesday, July 28, 2021 10:00-10:40
Session Chair: Lianqing Liu, Shenyang Institute of Automation, Chinese Academy of Science

Manipulation Skill Learning for Robots

Rong Xiong

Professor
College of Control Science and Engineering
Zhejiang University, China

Abstract:
Since the birth of the first robot, manipulation has been a classic and hot issue in the field of robot. It is a fundament function widely demanded in the fields of industry, logistics, agriculture, forestry, medical, service, and etc. At present, large-scale mature applications of manipulators have been formed in industrial manufacturing, but its working mode is mainly limited in fixed scenes with fixed pose and fixed process. In another word, the reliability and repeatability of task execution are ensured via the scene is fully controllable. When manipulators are applied in other scenes which have the general characteristics of open, including diverse objects, hybrid stacking, dynamic change, unknown object and various uncertainties, it raises great challenges to the adaptability, robustness and efficiency of robot operation. In recent years, manipulation skill learning of robot is proposed and researched. This talk mainly discusses its definition and key issues involved, and introduces our recent work on this issue.

Biography:
Rong Xiong, professor and leader of robotics group at the College of Control Science and Engineering, Zhejiang University, expert member of key special project on intelligent robot of Ministry of Science and Technology, China, vice president of international trustee committee of RoboCup, and associate editor of IET Cyber-Systems and Robotics. Her research interests include perception, learning and control for mobile robot, manipulator and humanoid robot. She has published more than 100 academic papers, been authorized more than 60 national invention patents and 2 USA invention patent where 22 patents are used or transferred by enterprises. She has successfully verified the techniques in the fields of special, aerospace, nuclear energy, port and so on, and cultivated a new generation of industrial mobile robot products with large scale applications. She won the first prize of Zhejiang science and technology award, the first prize of Zhejiang teaching achievement award, the second prize of national teaching achievement award, the National May 1st women's medal and the Baosteel excellent teacher award.

Keynote Talk 2: Thursday, July 29, 2021 10:00-10:40
Session Chair: Jing Xu, Tsinghua University

Self Powered Soft Robot for Deep Sea Exploration

Tiefeng Li

Professor
School of Aeronautics and Astronautics
Zhejiang University, China

Abstract:
The deep sea remains the largest unknown territory on Earth because it is so difficult to explore. Owing to the extremely high pressure in the deep sea, rigid vessels and pressure-compensation systems are typically required to protect mechatronic systems. However, deep-sea creatures that lack bulky or heavy pressure-tolerant systems can thrive at extreme depths. Here, inspired by the structure of a deep-sea snailfish, we develop a co-robot of untethered soft body for deep-sea exploration, with onboard power, control and actuation protected from pressure by integrating electronics in a silicone matrix. This self-powered robot eliminates the requirement for any rigid vessel. Careful design of the dielectric elastomer material used for the robot's flapping fins allowed the robot to be actuated successfully in a field test in the Mariana Trench down to a depth of 10,900 metres and to swim freely in the South China Sea at a depth of 3,224 metres. Our work highlights the potential of designing soft, lightweight devices for use in extreme conditions.

Biography:
Prof. Tiefeng Li received his Ph.D. degree in Solid mechanics from Zhejiang University (Joint Ph.D. program with Harvard University) in 2012. He is currently leading the lab of soft robot and intelligent system in the Center of X-Mechanics. He has dedicated himself in the research field of soft matter mechanics and soft robotics. He published 50 SCI papers (3 ESI highly cited papers), including 1 Nature cover paper, 1 Science Advances paper. He received the NSFC Outstanding Young Scholars, the first Xpoler Prize (Frontier and interdisciplinary research).

Keynote Talk 3: Thursday, July 29, 2021 17:05-17:45
Session Chair: Bingtuan Gao, Southeast University

How much we can rely on the networks of the future? – Privacy and security of future networks

Muhammad Ali Imran

Professor
James Watt School of Engineering
University of Glasgow, UK

Abstract:
With growing reliance of our everyday life on digital connectivity, our concerns for the privacy preservation and security of our data are exponentially growing. In this talk, we will explore what potential use cases are driving this increasingly popular vision of very private and highly secure wireless and wired networks. We will focus a bit more on wireless network challenges in terms of both privacy and security. We will then share some recent progress and findings on how future technologies designed for other purposes can actually help us achieve our goal of privacy preservation and security enhancement of wireless networks. Two particular technologies that will be re-visited in this light are block-chain for privacy preservation and intelligent reflective surfaces for security enhancement.

Biography:
Muhammad Ali Imran (M'03, SM'12) Fellow IET, Senior Member IEEE, Senior Fellow HEA is Dean University of Glasgow UESTC and a Professor of Wireless Communication Systems with research interests in self organised networks, wireless networked control systems and the wireless sensor systems. He heads the Communications, Sensing and Imaging (CSI) research group at University of Glasgow and is Director of Centre for Educational Development and Innovation. He is an Affiliate Professor at the University of Oklahoma, USA; Adjunct Research Professor at Ajman University, UAE and a visiting Professor at 5G Innovation Centre, University of Surrey, UK. He has over 20 years of combined academic and industry experience with several leading roles in multi-million pounds funded projects. He has filed 15 patents; has authored/co-authored over 400 journal and conference publications; has authored 2 books, edited 8 books and authored more than 30 book chapters; has successfully supervised over 40 postgraduate students at Doctoral level. He has been a consultant to international projects and local companies in the area of self-organised networks.

Keynote Talk 4: Friday, July 30, 2021 10:00-10:40
Session Chair: Fei Chen, Chinese University of Hong Kong

In-situ NanoRobotic Prototyping of Nanosensors for Cyber Physical Microsystems

Lixin Dong

Professor
Department of Biomedical Engineering
City University of Hong Kong, China

Abstract:
One of the common challenges for microrobots, neuro dusts, smart dusts and other micro-sized elements in cyber physical systems is their functionalization while keeping a miniaturized size. For microrobots, tremendous attention has been paid to the locomotion, navigation, chemical functionalization for biocompatibility, and various designs for cargo carrying. However, most micro-sized robots still look like specially shaped particles or colloids while the others are still big in sizes. On the other hand, the advancement of low dimensional nanomaterials has provided possibilities to tackle the barrier in integrating these carriers with such devices as wireless energy/signal transmitters, sensors, actuators, and tools built from them. This talk briefly reviews the recent advancement of nanorobotic manipulation for *in-situ* prototyping of nanosensors based on transmission electron microscopy (TEM), scanning TEM (STEM), and scanning electron microscopy (SEM), and highlights recent trends in embedding structural and collective intelligence into microsystems. Essential techniques for rapid prototyping and device-level structure-property correlation are demonstrated using nanorobotic assembly, sliding probes, STEM-EELS (electron energy loss spectroscopy), and a variety of stimuli and chips for *in-situ*nanorobotic technologies, which enable rapid prototyping of nanosensors, provide boundary conditions for nanodevice simulation, assist to determine structural parameters for their design and optimization, and serve for the quality control of batch-fabricated systems.

Biography:
Lixin Dong is a Professor at City University of Hong Kong. He received his Ph.D. degree in Micro Systems Engineering from Nagoya University in 2003 and became Assistant Professor there in the same year. Prior to join City University of Hong Kong, he has been an Associate Professor at Michigan State University by 2019 where he had been the founder and director of NanoRobotic Systems Lab. He held a Senior Research Scientist at ETH Zurich by 2008, where he had led the NanoRobotics Group in the Institute of Robotics and Intelligent Systems (IRIS) between 2004 and 2008. His main research interests include nanorobotics, nanoelectromechanical systems (NEMS), and enabling manufacturing technologies for fluidic, photonic, and biomedical systems. He introduced 3D nanorobotic manipulation in 2000 and co-invented artificial bacteria flagella in 2007. He received the NSF Career Award in 2011 for intelligent nanorobotic end-effectors, the IEEE T-ASE Googol Best New Application Paper Award in 2007 for nanotube linear servo motors, and some 30 other awards. He has served as Vice President for Conferences, IEEE Nanotechnology Council (NTC), a Senior Editor of the IEEE Transactions on Nanotechnology, and a member of the Publication Activities Board (PAB), IEEE Robotics and Automation Society.

Workshops

Workshop 1: Tuesday, July 27, 2021 14:00-18:00
Session Chair: George Zhang, Shenzhen Academy of Robotics;
Jizhang Liu, Jiangsu University

Agricultural Robotics and Applications

Abstract:
Agriculture is under its way of modernization thanks to the research and development of robotics and automation technologies. This workshop will overview the status and advancement of agricultural robotics, introduce object-recognition and ripeness-identification and greenhouse farming manipulation, and present the state-of-the-art testing systems and products. The goal of the workshop is to exchange the research ideas and development skills among academia, research institution and product manufacturing in order to improve the environment for collaboration and cooperation in this rapidly growing area.

Speakers:

- **Jizhang Liu**, Jiangsu University
  The Peak Season of Agrobot Technology is Coming
- **Fei Chen**, Chinese University of Hong Kong
  Grapevine Recognition, Manipulation and Robot Harvesting and Pruning Automation
- **Pengbo Wang**, Soochow University
  What Robots can Contribute to Greenhouse Farming? From Development to Practice

Workshop 2: Tuesday, July 27, 2021 14:00-18:00
Session Chair: Yuliang Zhao, Northeastern University;
Ying Wang, Beihang University

Sensing Devices and Applications on Biomedical Engineering and IoT

Abstract:
Sensing devices and applications are the fundamental of cyber technology in automation, control, and intelligent. This workshop mainly focused on the latest research results in intelligent sensing systems for applications in biomedical engineering, healthcare, robotics, the Internet, local or body networks, and intelligence systems. Researchers will report and discuss the sensing devices for future applications such as enhancing the performance of medical diagnosis systems, improving the stability and accuracy of wearable devices to monitor human health constantly, advancing safety and security levels in transportations, building, and factories, augmenting robotics capabilities by improving motion sensor-based position tracking, as well as integration of sensors and artificial intelligence techniques to create advanced ubiquitous cyber-physical sensing networks.

Speakers:

- **Ying Wang**, Beihang University
  Drug Delivery based on Nano/Micro Poking
- **Yuqiang Fang**, Jilin University
  Mechanical Modeling of Cell Adhesion
- **Ruihuan Yang**, Anhui Medical University
  Development of Intelligent Structures and Robots based on Smart Polymers and 3D Printing
- **Xin Tang**, Beijing Institute of Technology
  Recent Progress on Colloidal Quantum Dots Infrared Detectors for High-performance Thermal Imaging
- **Shuyu Wang** Northeastern University
  A Highly Stretchable Hydrogel Sensor for Soft Robot Multi-modal Perception
- **Jianying Zheng**, Soochow University
  Traffic Information Sensing based on Roadside LiDAR
- **Fei Fei**, Nanjing University of Aeronautics and Astronautics
  Design of Reconfigurable Robots based on Origami Structure
- **Yuliang Zhao**, Northeastern University
  AIoT Sensors for Varies Specialized Applications

IEEE-CYBER 2021 Conference Program

<table>
<tr><th colspan="4">July 27 (Tuesday)</th></tr>
<tr><td rowspan="2">14:00-18:00</td><td rowspan="2">Registration</td><td>Aegean Sea A, 2/F</td><td>Aegean Sea C, 2/F</td></tr>
<tr><td>Workshop 1: Agricultural Robotics and Applications
(for onsite attendees only)</td><td>Workshop 2: Sensing Devices and Applications on Biomedical Engineering and IoT
(for onsite attendees only)</td></tr>
<tr><td>18:00-20:00</td><td></td><td colspan="2">Welcome Reception
at Ruby Western Restaurant, 3/F (for all registered attendees)</td></tr>
</table>

<table>
<tr><th colspan="5">July 28 (Wednesday)</th></tr>
<tr><td></td><td rowspan="11">Registration</td><td colspan="3">Ramada Grand Ballroom A, 5/F</td></tr>
<tr><td>08:50-09:00</td><td colspan="3">Opening Ceremony</td></tr>
<tr><td>09:00-10:00</td><td colspan="3">Plenary Talk 1: Aiguo Song, Southeast University, China
Power Inspection Teleoperation Robot Technology in Complex Environment</td></tr>
<tr><td>10:00-10:40</td><td colspan="3">Keynote Talk 1: Rong Xiong, Zhejiang University, China
Manipulation Skill Learning for Robots</td></tr>
<tr><td>10:40-11:00</td><td colspan="2">Coffee Break</td><td>WePo1:
Poster Session 1</td></tr>
<tr><td>11:00-12:30</td><td colspan="3">WeR1:
Best Paper Session 1</td></tr>
<tr><td>12:30-13:30</td><td colspan="3">Lunch at Ruby Western Restaurant, 3/F (for all registered attendees)</td></tr>
<tr><td></td><td>Ramada Grand Ballroom A, 5/F</td><td>Juxian A, 5/F</td><td>Jude B, 5/F</td></tr>
<tr><td>13:30-15:00</td><td>WeR2:
Mobile Robotics</td><td>WeA2:
Industrial Robotics and Applications</td><td>WeB2:
Robot Planning and Control</td></tr>
<tr><td>15:00-15:30</td><td colspan="2">Coffee Break</td><td>WePo2:
Poster Session 2</td></tr>
<tr><td>15:30-17:00</td><td>WeR3:
SLAM and Navigation</td><td>WeA3:
Field Robotics</td><td>WeB3:
Intelligent Sensing and Control</td></tr>
</table>

<table>
<tr><th colspan="4">July 29 (Thursday)</th></tr>
<tr><td></td><td rowspan="13">Registration</td><td colspan="3">Ramada Grand Ballroom A, 5/F</td></tr>
<tr><td>09:00-10:00</td><td colspan="3">Plenary Talk 2: Matthew McKay, Hong Kong University of Science and Technology, China
Computational Approaches for Guiding Rational Vaccine Design: Case Studies of HIV, HCV and COVID-19</td></tr>
<tr><td>10:00-10:40</td><td colspan="3">Keynote Talk 2: Tiefeng Li, Zhejiang University, China
Self Powered Soft Robot for Deep Sea Exploration</td></tr>
<tr><td>10:40-11:00</td><td colspan="2">Coffee Break</td><td>ThPo3:
Poster Session 3</td></tr>
<tr><td>11:00-12:30</td><td colspan="3">ThR1
Best Paper Session 2</td></tr>
<tr><td>12:30-13:30</td><td colspan="3">Lunch at Ruby Western Restaurant, 3/F (for all registered attendees)</td></tr>
<tr><td></td><td>Ramada Grand Ballroom A, 5/F</td><td>Juxian A, 5/F</td><td>Jude B, 5/F</td></tr>
<tr><td>13:30-15:00</td><td>ThR2:
Sensing and Recognition</td><td>ThA2:
Power Systems</td><td>ThB2:
Automaton in Pavement and Bridge</td></tr>
<tr><td>15:00-16:30</td><td>ThR3:
Perception and Recognition</td><td>ThA3:
Intelligent Energy Systems</td><td>ThB3:
Sustainable Energy Systems</td></tr>
<tr><td>16:30-16:50</td><td colspan="2">Coffee Break</td><td>ThPo4:
Poster Session 4</td></tr>
<tr><td></td><td colspan="3">Ramada Grand Ballroom A, 5/F</td></tr>
<tr><td>16:50-17:05</td><td colspan="3">Development of Cybertechnolpogy Ecosystem in Jiaxing
嘉兴数字智能产业发展生态</td></tr>
<tr><td>17:05-17:45</td><td colspan="3">Keynote Talk 3: Muhammad Ali Imran, University of Glasgow, UK
How much we can rely on the networks of the future? – Privacy and security of future networks</td></tr>
<tr><td>18:00</td><td></td><td colspan="3">Conference Banquet and Award Presentation
at Ramada Grand Ballroom B, 5/F (for all registered attendees)</td></tr>
</table>

<table>
<tr><th colspan="5">July 30 (Friday)</th></tr>
<tr><td></td><td rowspan="9">Registration</td><td colspan="3">Ramada Grand Ballroom A, 5/F</td></tr>
<tr><td>09:00-10:00</td><td colspan="3">Plenary Talk 3: Haibin Yu, Shenyang Institute of Automation, CAS, China
Wireless Networks for Industrial Automation: From WIA to 5G</td></tr>
<tr><td>10:00-10:40</td><td colspan="3">Keynote Talk 4: Lixin Dong, City University of Hong Kong, Hong Kong, China
In-situ Nano Robotic Prototyping of Nanosensors for Cyber Physical Microsystems</td></tr>
<tr><td>10:40-11:00</td><td colspan="3">Coffee Break</td></tr>
<tr><td></td><td>Ramada Grand Ballroom A, 5/F</td><td>Juxian A, 5/F</td><td>Jude B, 5/F</td></tr>
<tr><td>11:00-12:30</td><td>FrR1:
Power and Energy Systems</td><td>FrA1:
Optimization and Control</td><td>FrB1:
Measurement and Prediction</td></tr>
<tr><td>12:30-13:30</td><td colspan="3">Lunch at Ruby Western Restaurant, 3/F (for all registered attendees)</td></tr>
<tr><td>13:30-15:00</td><td>FrR2:
Machine Learning and Applications</td><td>FrA2:
Agriculture Robotics</td><td>FrB2:
Mechanism and Control</td></tr>
<tr><td>15:00-17:00</td><td></td><td colspan="3">Farewell Reception
at Ramada Grand Ballroom B, 5/F (for all registered attendees)</td></tr>
</table>

Wednesday Sessions

WePo1: Poster Session 1

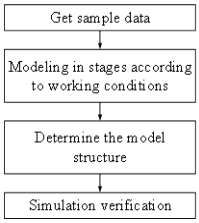
Room : Grand Ballroom Foyer, 10:40-11:00, Wednesday, July 28, 2021

WePo1(1) 10:40-11:00

Unified Model of HVDC Rectifier Station with Controller under Different Operating Conditions

Huan Yuan
Hohai University
Yan Lv
China Electric Power Research Institute

- Judging the operating conditions of the rectifier station according to different voltage drops
- Modeling the rectifier station by stages and operating conditions
- Using goodness of fit as an indicator to evaluate the modeling situation of each module



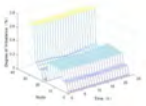
Modeling process

WePo1(2) 10:40-11:00

Distributed photovoltaic configuration optimization based on three-phase unbalance under time sequence

Chen Yun Zhao
Electric Power Research Institute, Hohai University, China
Yan Sheng Lang
State Key Laboratory of Power Grid Safety and Energy Conservation, China
Electric Power Research Institute Beijing, China

- Negative sequence voltage and three-phase unbalance are suppressed.
- The Bacterial Colony Chemotaxis Optimization algorithm is used to search the Pareto optimal solution set.
- The coordination between single-phase/three-phase photovoltaic and SVG.
- The multi-objective optimization results improve the balance and economy of the distribution network.



Optimized three-phase unbalance

WePo1(3) 10:40-11:00

Design and Analysis of a Novel Soft Bending Actuator Based on Eccentric Structure *

Kai Li, Daohui Zhang, Xingang Zhao, Yaqi Chu
the State Key Laboratory of Robotics, Shenyang Institute of Automation (SIA), Chinese Academy of Sciences (CAS), China
Institutes for Robotics and Intelligent Manufacturing, Chinese Academy of Sciences (CAS), China
University of Chinese Academy of Sciences (UCAS), China

- The eccentric soft bending actuators (ESBAs) with circular cavities were proposed to solve the high-stress concentration problem and improve the performance.
- The maximum bending angle and output force of the proposed ESBAs could reach 131.6˚and 1.5N at 190kPa.

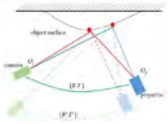
The design proposals of cavity shape.

WePo1(4) 10:40-11:00

Sub-Pixel Depth Perception Based on Flexible and Separated Structured Light

Wang Hongyu, School of Mechanical Engineering, Tsinghua University, China
Li Dongxue Xu Fang, Wang Yixiao
School of Robotics and Engineering, Northeastern University, China

- We develop the method of machine learning for sub-pixel depth perception based on flexible and separated structured light, and describe novel framework for getting the extrinsic parameters of the system without complicated calibration in advance.
- We combined the extrinsic parameter calculation process into the structured light decoding process. PSO-C4.5 Decesion Tree algorithm is used to classify and match sub-pixel based on the Label.



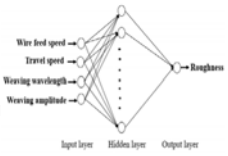
The schematic diagram of flexible and separated structured light

WePo1(5) 10:40-11:00

Predicting Layer Roughness with Weaving Path in Robotic Wire Arc Additive Manufacturing Using Multilayer Perceptron

Ahmed Yaseer, Heping Chen
Ingram School of Engineering, Texas State University, USA
Biao Zhang
US Research Center, ABB Inc., Raleigh, North Carolina, USA

- Construct a model between layer roughness and welding parameters
- Propose weaving path to reduce layer roughness
- Measure layer roughness using a lase scanner.
- Predict roughness with Multilayer Perceptron using welding parameters



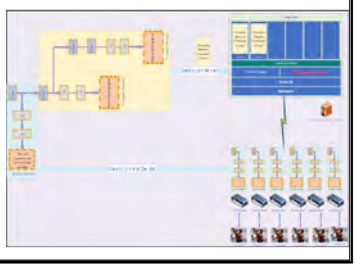
MLP architecture for roughness prediction

WePo1(6) 10:40-11:00

A Fast and Energy-Saving Neural Network Inference Method for Fault Diagnosis of Industrial Equipment Based on Edge-End Collaboration

Qizhao Wang, Qing Li, Kai Wang and Hong Wang
Shenyang Institute of Automation, Chinese Academy of Sciences, China
Guangshu Jin and Zuye Yang
Microcyber Corporation, China

- A fast and energy-saving edge-end neural network reasoning method is proposed.
- The system is implemented by a neural network with a multi-branch structure.
- Simple branches are deployed on terminal devices, and complex branches are deployed on edge servers.



WePo1: Poster Session 1 (cont.)

Room : Grand Ballroom Foyer, 10:40-11:00, Wednesday, July 28, 2021

WePo1_2(7) 10:40-11:00

Structure design and finite element analysis of a three axis mechanical arm

Xiaofeng Du , George Zhang , JiangCheng Chen, Ning Xi*
Shenzhen Academy of Robotics
Shenzhen, Guangdong province, China

Aiming at the demand of a small size mechanical arm with simple transmission structure, low cost and low center of gravity for mobile platform and serving in educational or other non-manufacturing applications, a three axis mechanical arm is designed, analyzed and discussed in this paper.

- Firstly, according to the design requirements, the main technical parameters of the mechanical arm are determined, and the 3D model of each component of the mechanical arm is established by Solidworks software, and the joint transmission structure design and the whole triaxial mechanical arm assembly are completed.
- Secondly, the torque, angular acceleration and moment of inertia needed to drive the three-axis manipulator are calculated, and the joint motors and reducers are selected.
- Finally, the ANSYS Workbench software is used to static analysis of the mechanical arm link, when the load is 2kg, the deformation of the first axis mechanical arm link is 0.056mm and the deformation of the whole three axis mechanical arm link is 0.084mm, which meets the design requirements of the overall three axis mechanical arm.

A three axis mechanical arm

WePo1_2(8) 10:40-11:00

Optimal Sliding Mode Control of ROV Fixed Depth Attitude Based on Reinforcement Learning

Wang Fule, Qu Qiuxia, Yuan Baolong, Sun Liangliang, Guo Guanyan, Xiao Zupeng and Sun Liang
School of information and control engineering, Shenyang JianZhu university, CHINA
Li Zhigang
Shenyang institute of automation, Chinese academy of science, CHINA

- Fixed depth attitude control of ROV
- Adaptive dynamic programming
- Approximate optimal sliding mode controller
- Verification of asymptotic stability for Lyapunov equation

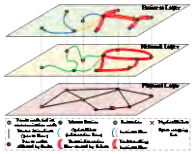
Appearance diagram of ROV

WePo1_2(9) 10:40-11:00

Anomaly Detection Method Based on Bilateral Features for CPPS

Yunan Zhang, Yixin Jiang, Aidong Xu,
Xiaoyun Kuang, Chao Hong and Jiaqi Chen
Guangdong Provincial Key Laboratory of Power System Network Security,
Electric Power Research Institute,
China Southern Power Grid, Guangzhou, China

- The influence of power system state on the communication network traffic
- Behavior features of communication side and discretized features of physical side
- The data-driven method based on behavior features to distinguish burst flows from normal flows
- Method based on bilateral features identify abnormal burst flows caused by cyberattacks



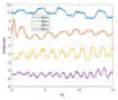
Schematic diagram of the influence of the physical side state on the information flow in CPPS

WePo1_2(10) 10:40-11:00

Image-based non-contact respiration monitoring system for people wearing masks

Shengzhao Zhang, Miao Li, Yingying Li, and Runhuai Yang*
School of Biomedical Engineering, Anhui Medical University, China

- Non-contact long-distance monitoring system
- Predict, monitor, and track COVID-19
- Breathe detection



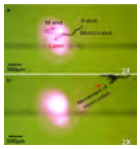
Breathe detection by CMOS camera

WePo1_2(11) 10:40-11:00

The simulation and experimental study on laser driven micro-robot

Weijie Zheng and Didi Li and Shilu Zhu and Liang Cheng and Runhuai Yang*
School of Biomedical Engineering, Anhui Medical University, China

- Laser driven micro-robot
- Finite element simulation
- Polymer based microswimmer



Experimental diagram of laser driven micro-robot displacement

WePo1_2(12) 10:40-11:00

Pipeline Leak Detection, Location and Repair

Peihan Lin, Xiaoming Li, Zhoubin Long, Peili Ma,
Wenji Li, Guijie Zhu , Jiahong Wei and Zhun Fan*
Key Lab of Digital Signal and Image Processing of Guangdong Province,
Engineering college, Shantou University, China

- 1.A robot system with a manipulator for pipeline leak-sealing.
- 2.A novel caulking actuator is designed to seal leaks on the pipeline.
- 3.A framework for pipeline leak detection and location based on deep learning using stereo camera.

Experimental setup

WePo1: Poster Session 1 (cont.)

Room : Grand Ballroom Foyer, 10:40-11:00, Wednesday, July 28, 2021

WePo1_3(13) 10:40-11:00

Fault-Aware Robust Control via Adversarial Reinforcement Learning

Fan Yang, Chao Yang, Di Guo, Huaping Liu and Fuchun Sun
The Department of Computer Science and Technology,
Tsinghua University, China

- Traditional robot algorithm can hardly adapt to any robot damage like animals do.
- We proposed an adversarial reinforcement learning algorithm, which increase the robustness over damage.
- We evaluated the increased robustness of our algorithm on the D'Claw robot and the D'Kitty robot.

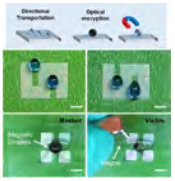
The figure shows a robot with two damaged joints and a robot without damage turning the valve.

WePo1_3(14) 10:40-11:00

Towards microfluidic-based optical encryption using superhydrophobic surfaces created by femtosecond laser ablation

Jianchen Zheng[1,2,3], Haibo Yu[1,2], Yangdong Wen[1,2], Wenxiu Zhao[1,2,3], Hao Luo[1,2,3], Lianqing Liu[1,2], Wen Jung Li[1,2,4]
[1]State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, Shenyang 110016, China
[2]Institutes for Robotics and Intelligent Manufacturing, Chinese Academy of Science, Shenyang 110016, China
[3]University of Chinese Academy of Sciences, Beijing 100049, China
[4]Department of Mechanical Engineering, City University of Hong Kong,China

- Micro-/nano-structures were created on PDMS substrate via femtosecond laser ablation
- A superhydrophobic surface was prepared for droplets transportation and optical encryption utilizing a high-contrast difference in surface wettability
- Self-cleaning properties were demonstrated



WePo1_3(15) 10:40-11:00

Posture Tracking Algorithm based on MEMS -AHRS -Module for High Speed Train Surveillance

First Author/ Hai-Tao Li
Members/Jin-He ,Xiang-Li, Jing Liu

This dissertation focuses on the three-dimensional attitude calculation of high-speed train in the complicated driving process, an adaptive kalman filter algorithm based on the fusion of low-cost MEMS gyroscope, accelerometer and magnetometer is proposed. This algorithm can keep the roll and pitch accuracy at 0.1 ° and the heading angle accuracy at 0.2 °.

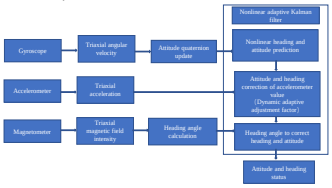


Figure 1:Frame diagram of dynamic adaptive Kalman filter

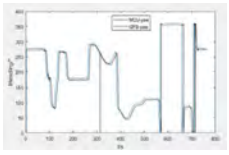


Figure2 :AHRS-heading && GPS-heading

WePo1_3(16) 10:40-11:00

Multi-sensing System for Commercial Aircraft Rudder Surface Surveillance Based on Micro IMUs

Dapeng Chen, Sheng Chen, Yepu Song and Jingxian Zhang
COMAC Shanghai Aircraft Manufacturing Co.Ltd., Shanghai, China

- The micro inertial measurement systems (IMUs) and the mode of wireless transmission are designed.
- Real-time detection of each aircraft rudder surface and elimination of measurement errors.
- The errors of the angle of aircraft rudder surface is lower than 0.1 degree.

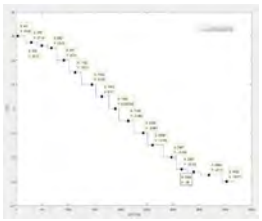


Figure1: The angle of aircraft rudder

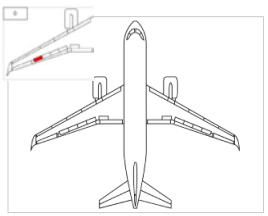


Figure2: The model aircraft

WeR1: Best Paper Session 1

Session Chair: Xingang Zhao

Room : Ramada Grand Ballroom A, 11:00-12:30, Wednesday, July 28, 2021

WeR1(1) 11:00-11:15

Semi-autonomous Navigation Control System of Intelligent Wheelchair Based on Asynchronous SSVEP-BCI

Jingyu Ping and Fei Wang
Faculty of Robot Science and Engineering, Northeastern University, China
Zongfeng Xu, Jinying Bi and Ling Xiao
College of Information Science and Engineering, Northeastern University, China

- A two-layer human-computer interaction interface is designed to evoke SSVEP signals.
- The method based on variance statistic of spectrum energy is proposed for idle state detection.
- The intelligent wheelchair system provides destination mode and roaming mode to meet people's requirements

Intelligent wheelchair.

WeR1(2) 11:15-11:30

joint angle selection criterion & Decoupling control method in shaft-hole assembly

Junhe Wang and Song Lin
University of Chinese Academy of Sciences, China
Yong Jiang and Fanxu Kong
Shenyang Institute of Automation Chinese Academy of Sciences, China

- Geometric model-based joint angle selection criterion for force parameter identification & Decoupling control method of position and posture in shaft-hole assembly Use Arial 28pt font in bold face for the title
- Decoupling control method of position and posture to improve safety
- Use velocity-based compliance control to improve system responsiveness
- Speed control using Euler angles

Experimental diagram

WeR1(3) 11:30-11:45

Grapevine Winter Pruning Automation: On Potential Pruning Points Detection through 2D Plant Modeling using Grapevine Segmentation

Miguel Fernandes[1,2] and Antonello Scaldaferri[1] and Giuseppe Fiameni[3] and Tao Teng[1,4] and Matteo Gatti[4] and Stefano Poni[4] and Claudio Semini[5] and Darwin Caldwell[1] and Fei Chen[6]
IIT-AprilLab[1], UniGe[2], NVAITC[3], UCSP[4], IIT-DLS[5], CUHK-CURI[6]

- Automation of grapevine winter pruning with a mobile robotic platform.
- Annotation of a grapevine dataset with segmentation information with different plant organs.
- Creation of a Plant Graph based on the segmentation output of a neural network.
- Generation of potential pruning points based on the created graph information.

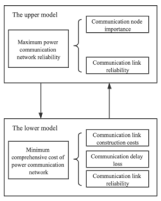
Example of manual grapevine pruning and our robot performing grapevine pruning with the wanted plant modeling

WeR1(4) 11:45-12:00

A Resilient Scheduling Scheme for Power Communication Networks Considering Extreme Events

Shutan Wu and Qi Wang
School of Electrical Engineering, Southeast University, China

- The importance evaluation method of communication nodes by using the optimal load cutting algorithm
- Propose the reliability evaluation index of communication links under extreme events
- The two-layer cooperative optimization model of power communication network
- The typhoon risk resistance strategy of power communication network is put forward



Two-layer collaborative optimization model of power communication network

WeR1(5) 12:00-12:15

Sliding Mode Control Strategy for Land Vehicle Platoon Based on ELM Parameter Observer

Lingli Yu and Yu Bai
School of Automation, Central South University, China

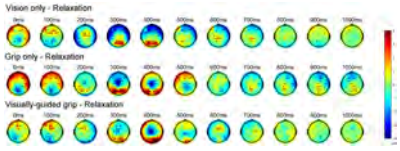
In order to eliminate the effects of uncertain parameters in the intelligent vehicle platoon, a sliding mode control strategy based on extreme learning machine is presented in this paper. Firstly, considering the communication topology between the vehicle platoon, the vehicle platoon dynamics model is established, and the vehicle platoon distance error model is obtained based on the constant time distance strategy. Then, aiming at the uncertainty of some parameters in the model, a sliding mode control strategy based on ELM parameter observer is proposed. Finite-time stability and string stability of the system are analyzed by constructing Lyapunov function. Finally, Trucksim/Simulink simulation further verify the effectiveness of the method in this research. The results show that the proposed method can accurately estimate the uncertainty parameters in the vehicle platoon, guarantee the string stability, and realize the rapid convergence of errors.

WeR1(6) 12:15-12:30

An Effective Connectivity Analysis Method to Explore Visual-motor Coordination during A Grip Task

Ting Song, Zhilin Shu, Yuchen Yang, Jianda Han and Ningbo Yu
College of Artificial Intelligence, Nankai University, China
Tianjin Key Laboratory of Intelligent Robotics, Nankai University, China

- A hand-grip experiment was designed to explore visual-motor coordination, and the biological signals were recorded.
- An effective analysis method was proposed to investigate the brain-brain and brain-muscle interaction.
- Connectivity was higher during grip than relaxation and vision only, and the dynamics was discussed.



Topographical maps of brain activation after the grip started.

WeR2: Mobile Robotics

Session Chair: Yunxia Wang

Room : Ramada Grand Ballroom A, 13:30-15:00, Wednesday, July 28, 2021

WeR2(1) 13:30-13:45

Hierarchical Planning Algorithm for Redundant Mobile Manipulators to Follow a Given Trajectory

Chen Liu, Xunlei Shi and Libin Song
Department of Mechanical Engineering, Tsinghua University, China
Weichun Feng and Yu Liu
Beijing Institute of Tracking and Telecommunications Technology, China

- Decoupled method to plan the motion of the mobile manipulator separately
- Analyzed the distribution of the manipulator's manipulability and adopted polynomials to fit the feasible workspace's boundary.
- Adopted DP to compute an initial path of the base and GD to optimize it.
- Guarantee the manipulator's manipulation capability and optimize the movement of the base

WeR2(2) 13:45-14:00

A High-Throughput Phenotyping Robot for Measuring Stalk Diameters of Maize Crops

Zhengqiang Fan, Na Sun, Quan Qiu*, and Tao Li
Beijing Research Center of Intelligent Equipment for Agriculture,
Beijing Academy of Agriculture and Forestry Sciences, China
Chunjiang Zhao
Beijing Research Center for Information Technology in Agriculture,
Beijing Academy of Agriculture and Forestry Sciences, China

- An ultra-narrow HTPP robot capable of traveling below the canopy of row crops is developed
- A real-time stalk detection algorithm for maize crops in open-field is presented
- A simple and effective approach for calculating the stalk diameters with RGB-D cameras is proposed

High-throughput phenotyping robot

WeR2(3) 14:00-14:15

Design of the Control System for the Dining Service Robot on the overhead monorail

Ajian Liu, Yunxia Wang, Aiqin Sun, Jidai Wang
School of Mechatronic Engineering, Shandong University of Science and Technology, China

- 1. The control system with STM32 as the core is designed
- 2. Realize the positioning of the table through RFID and electronic tags
- 3. Restaurant PC monitoring platform software was developed
- 4.A speed adjustment method based on double fuzzy control is proposed

Dining Service Robot on the Overhead Monorail

WeR2(4) 14:15-14:30

A Robot Obstacle Avoidance Approach with LiDAR and RGB Camera Data Combined

Zesen Liu, Chuanhong Guo, Sheng Bi*, Kezheng Yu, Guojun Peng, Yuyang Yue
School of Computer Science and Engineering,
South China University of Technology, China

- Designed and implemented the overall architecture of the robot obstacle avoidance approach combining LiDAR and RGB camera data.
- Designed a deep learning network model based on MobileNetV2 for obstacle detection and deployed it to the mobile robot running on an embedded system.
- Designed a costmap level fusion strategy of LiDAR and Camera data, enabling the robot to detect obstacles that were previously undetectable and understand the surroundings better.

Experimental site with obstacles marked

WeR2(5) 14:30-14:45

Fault-Tolerant Multi-Robot Target Pursuit with Fault Detection and Isolation Based on Mobile Adaptive Networks

Jia You
ISEE, Zhejiang University, China
Zhenhui Li
CSE, Zhejiang University, China
Jianhua Yang
CST, Zhejiang University, China

- This paper proposes and investigates fault-tolerant mobile adaptive networks for multi-robot target pursuit
- The proposed algorithms perform better in convergence and accuracy than the original algorithms
- Simulation results have verified the efficacy of the proposed algorithms

WeA2: Industrial Robotics and Applications

Session Chair: Chin-yin Chen

Room : Juxian A, 13:30-15:00, Wednesday, July 28, 2021

WeA2(1) 13:30-13:45

Sphere sets from point clouds for efficient collision detection in robot motion planning

Alex Visser, Zengxi Pan and Stephen van Duin
Faculty of Engineering and Information Sciences,
University of Wollongong, Australia

- Modelling a robot work space for motion planning is a time consuming task
- Area scanners can quickly create a point cloud of an area, but a point cloud is not efficient in collision detection
- We present an algorithm to convert a point cloud into a set of spheres, enabling efficient collision checks

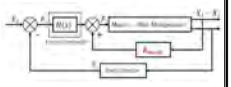
Algorithm Output

WeA2(2) 13:45-14:00

An Active Vibration Suppression Method for Macro-Mini Manipulator

Junjie Dai , Chin-Yin Chen, Renfeng Zhu, Guilin Yang, Chongchong Wang
Ningbo Instituteof Materials Technology and Engineering,Chinese Academy of Sciences, China
Shaoping Bai
Department of Materials and Production, Aalborg University, Denmark

- The impedance matching can realize the vibration suppression of macro-mini manipulators.
- We don't need to know the accurate dynamic model of the industrial robot.
- The maximum force error of the contact force obtained through experiments can be reduced by 8.6N



Impedance matching based on direct force control

WeA2(3) 14:00-14:15

Bi-RRT* based trajectory optimization and obstacle avoidance for a serial manipulator

Mukun Zhang, Ye Ma and Ning Xi
Department of Industrial manufactruing and systematic engineering, University of Hong Kong, China, Hong Kong

- Build a collision check model based on the distance calculation between point cloud and the manipulator
- A fast and smooth collision free path planning method based on Bi-RRT* algorithm is used to find a feasible path for the UR5.
- 5th order spline interpolation algorithm based trajectory planning method is used to generate a trajectory for the UR5.

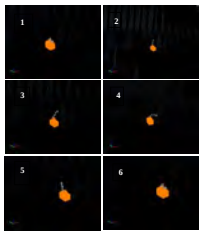


Figure caption is optional, use Arial 18pt

WeA2(4) 14:15-14:30

MIMO Model Predictive Control of Bead Geometry in Wire Arc Additive Manufacturing

Haochen Mu, Zengxi Pan, Yuxing Li, Fengyang He, Joseph Polden and Chunyang Xia
School of MMMB, University of Wollongong, Australia

- Control deposited bead geometry is one of key focal areas of WAAM.
- A control strategy is designed based on model predictive control and autoregressive model.
- The control strategy can reduce fluctuations in a part's height by 400%.
- The fluctuations in bead width along a single weld seam was improved by more than 50%

Inclined tube without (left) and with control (right)

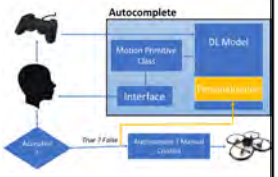
WeA2(5) 14:30-14:45

Personalized Autocomplete Teleoperation:

Real-Time User Adaptation using Transfer Learning with Partial Feedback

Mohammad Haj Hussein, Imad H. Elhajj, Daniel Asmar
Vision and Robotics Lab (VRL), American University of Beirut, Lebanon

- Autocomplete Teleoperation enhances teleoperation by recognizing operator intentions and automating the completion when instructed
- Personalized User Experience → Domain Adaptation using Transfer and Incremental Learning
- Yes/No User feedback → Partial Labeling formulation



Proposed Framework for Personalized Autocomplete

WeA2(6) 14:45-15:00

Non-autoregressive Dynamic Model Identification and Varying Bead Geometry Control in WAAM

Zhihu Li and Jing Xu
Department of Mechanical Engineering, Tsinghua University, China

- A non-autoregressive dynamic model is proposed to predict the bead geometry from welding parameter sequences.
- The fluidity of the welding pool is modelled by a Long Short Term Memory network.
- A model predictive control (MPC) method is proposed to plan welding parameters from bead geometry.
- Experiments show that the proposed methods are able to produce varying-geometry beads with high accuracy.

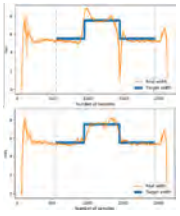


Figure 1 The geometry of beads produced by traditional and our methods

WeB2: Robot Planning and Control

Session Chair: Hongtai Cheng

Room : Jude B, 13:30-15:00, Wednesday, July 28, 2021

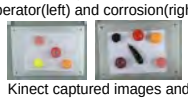
WeB2(1) 13:30-13:45

Research on Robot Visual Grabbing Based on Mechanism analysis

Haichao Liu and Zhitai Liu and Huanli Liu and Weiyang Lin
Research Institute of Intelligent Control and Sysmtems, Harbin Institute of Technology, China

- Robot visual grabbing based on model-based edge detection and classifier scheme.
- Compared with the Sobel operator edge extraction method, the superiority of the corrosion operation edge extraction method has been verified.
- Proposed classifier is based on artificially extracted object features. This classifier is efficient, light and interpretable.
- A robot grabbing experiment has been carried out, which shows the effectiveness and accuracy of the proposed scheme based on mechanism analysis.

Resulted edge image of Sobel operator(left) and corrosion(right)



Kinect captured images and their recognition effects

Visual grabbing result

WeB2(2) 13:45-14:00

Vision-based autonomous perceiving and planning system of a 7DOF robotic manipulator*

Linfeng Xu
Department of Mechanical & Aerospace Engineering, University of Florida, USA
Gang Li, Jiaping Li and Weixiang Shao
SIASUN Robot & Automation CO. LTD., China

- Design and implement a stabler environment perception method
- Design and implement a more accurate trajectory planning algorithm
- Simulation of the visual process and the planning algorithm
- Experiments in real environment test the performance

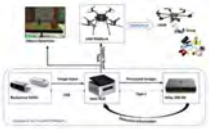
Collaborative manipulator

WeB2(3) 14:00-14:15

Onboard Real-time Object Detection for UAV with Embedded NPU

Long Chen, Jingyi Hu, Fengyu Quan and Haoyao Chen
School of Mechanical Engineering and Automation,
Harbin Institute of Technology Shenzhen, P.R. China
Xuanfu Li
Department of HiSilicon Research,
Huawei Technology Co., Ltd, P.R. China

- Unmanned aerial vehicles (UAVs)
- Real-time scenario analysis
- Use a novel pruning strategy to obtain a "slim" deep-learning network object detector
- Implement detection-reinitialization mechanism to realize the robust output of detection



Signal flows of the proposed object detection system.

WeB2(4) 14:15-14:30

Obstacle Avoidance of Multiple Manipulators Based on 3D Artificial Potential Field Method

Fei Xiao, Hailin Huang and Bing Li
School of Mechanical Engineering and Automation, Harbin Institute of Technology, Shenzhen, China
Fengfeng Xi
Department of Aerospace Engineering, Ryerson University, Toronto

- Obstacle avoidance of multiple manipulators
- Simplified manipulator model allows a simple computation while detecting collisions.
- Planning the paths via the 3D artificial potential field method
- Experimental results

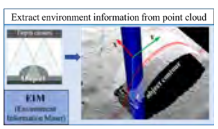
Obstacle avoidance

WeB2(5) 14:30-14:45

Environment Information-based Impedance Control

Yinghao Gao, Hailin Huang, Wenfu Xu, and Bing Li
School of Mechanical Engineering and Automation,
Harbin Institute of Technology, Shenzhen, China
Fengfeng Xi
Department of Aerospace Engineering, Ryerson University, Canada

- We proposed a novel approach which integrates depth camera into impedance control framework.
- The approach employs depth camera to extract environment information, which then is fed to the impedance controller.
- The method enables robots to perform force tracking on complex surfaces and even incontinuous surfaces.



WeB2(6) 14:45-15:00

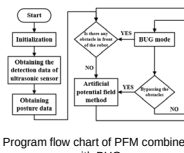
Local Path Planning of the Outdoor Blind Guiding Robot

Yuan Wenbo, Guo Yanchen, Hao Lina*, and Zhang Ying

Abstract— In this paper, an outdoor blind guiding robot is designed to meet the travel needs of the blind. Aiming at the problem of path planning of outdoor blind guiding robot, this paper adopts the idea of combining artificial potential field method and Bug algorithm to carry out local path planning and realizes the off-line aimless obstacle avoidance of outdoor blind guiding robot.

The artificial potential field method

$$f_{att} = \begin{cases} k_a(p_g - p) \\ k_a(p_g - p)\dfrac{p_0}{|p_g - p|} \end{cases}$$



Program flow chart of PFM combined with BUG

Simulation results of PFM with Bug

Local path planning experiment site

WePo2: Poster Session 2

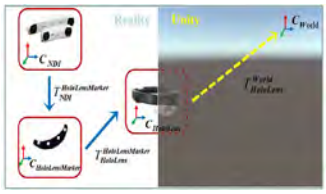
Room : Grand Ballroom Foyer, 15:00-15:30, Wednesday, July 28, 2021

WePo2(1) 15:00-15:30

A Spatial Calibration Method for Mixed Reality Devices

Shun Su, Guoli Song, Yiwen Zhao, Yang Luo and Xingang Zhao
Shenyang Institute of Automation, Chinese Academy of Sciences, China
Yinhui Wang
Northeastern University

- Mixed reality devices' calibration method
- Calibration error of rotation is 0.0016 rad
- Calibration error of tranlation is 1.731 mm

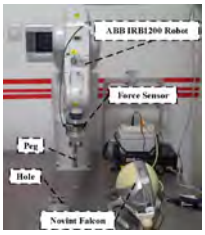


WePo2(2) 15:00-15:30

Learning Peg-in-Hole Assembly Skills from Demonstration Based on Geometric Constraints

Zhonglai Tian, Hongtai Cheng, Liang Zhao and Shuo Cao
School of Mechanical Engineering and Automation,
Northeastern University, China

- Segment assembly skills into different sub-skills based on geometric constraints and force sensor information
- Different strategies are used to learn assembly skills according to the feature of sub-skills
- The strategy based on geometric constraints can effectively distinguish search stage and inserting stage
- Hybrid force/Position Control is used to perform assembly, which is more robust to environmental disturbances

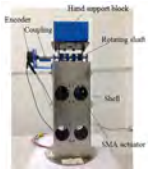


WePo2(3) 15:00-15:30

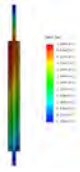
Design and control of a robotic wrist joint actuated by the shape memory alloy actuator

Mingfang Liu, Lina Hao

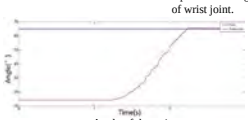
This paper proposes a humanoid wrist joint structure actuated by a new shape memory alloy (SMA) actuator, the stroke and the force of which are 20mm and 12N respectively. A new spindle is proposed to achieve to transform the straight motion of the SMA actuator into the rotation of humanoid wrist joint, and simplify the structure of the wrist joint. Finally a PID controller is applied to control the humanoid wrist joint. In this paper the new SMA actuator solves the limitation of short stroke and small output force of the conventional SMA actuator effectively. The proposed humanoid wrist joint provides a new idea for the SMA as a bionic actuator.



Robotic wrist.



Axial displacement diagram of wrist joint.



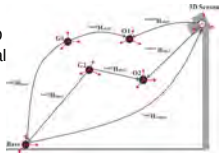
Angle of the wrist

WePo2(4) 15:00-15:30

Fast and Accurate 3D Eye-to-hand Calibration for Large-Scale Scene based on HALCON

Geng Wang, Wanlong Quan, Yaonan Li, Siwen Fang, Heping Chen, and Ning Xi
Shenyang Institute of Automation, Chinese Academy of Sciences, Shenyang
Shenzhen Academy of Robotics, Shenzhen

- This paper describes a fast and accurate 3D eye-to-hand calibration method for large-scal scene.
- A common tee pipe is used as calibration object.
- The experiments demonstrate that our method can achieve high calibration accuracy and significantly improve the efficiency of calibration.



Relative coordinate transformations of hand-eye calibration.

WePo2(5) 15:00-15:30

2021-07

Research on grid connected technology of matrix Converter based on virtual synchronous generator

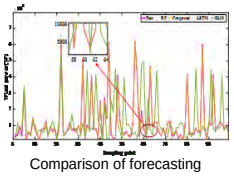
***Abstract*—In order to better integrate renewable energy into the distribution network, the matrix converter is used as the main circuit of the virtual synchronous power generation (VSG) technology. Make the grid-connected matrix converter have the characteristics of a synchronous generator. Aiming at the complex structure of the phase-locked loop (PLL) of the traditional VSG grid-connected system, this paper proposes a VSG-based matrix converter grid-connected technology without PLL. A new type of modulation strategy is adopted for the matrix converter. This strategy does not need to input the current space vector, and only needs the information of the given voltage space vector to output a better quality voltage. Through simulation and experiment, the validity and correctness of the proposed strategy are verified, and a new idea is provided for the cross-to-interchange and grid connection in distributed power generation.**

Guo Yougui (Professor)

WePo2(6) 15:00-15:30

Ultra-Short Term Power Prediction Of Wind Farm Based On EEMDSE-GGRU

Lingzhi Yi and Shitong Wang and Renzhe Duan and Bo Liu
Automation and electronic, XiangTan university, China
Xiaoping Song and Dong Deng
Xiangdian Wind Energy, China



Comparison of forecasting trends with different forecasting methods

WePo2: Poster Session 2 (cont.)

Room : Grand Ballroom Foyer, 15:00-15:30, Wednesday, July 28, 2021

WePo2_2(7) 15:00-15:30

A Task Scheduling Method for Edge Computing in Intelligent Building System

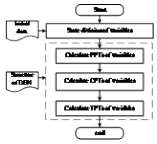
Lingzhi YI,
Hunan Multi-energy Cooperative Control Technology Engineering Research Center, Xiangtan University, China
Xiaodong FENG, Xieyi GAO and Peng JIANG
School of Automation and Electronic Information, Xiangtan University, China
Lv FAN and Huina SONG
Willfar Information Technologies Co.,Ltd, China

WePo2_2(8) 15:00-15:30

Dynamic Parameter Identification Technology of Distribution Network Line Based on Dynamic Graph Model

Jiangdong Liu, Zhijian Wu and Yule Wu
State Grid Yangzhou Power Supply Company, Yangzhou, China
Haibo Tang
School of Electrical Engineering, Southeast University, Nanjing, China
Jian Sun
Electric Power Research Institute of Jiangsu Electric Power Company, Nanjing, China

- A DBN model that reflects the relationship between the environment and line parameters is constructed.
- The proposed DBN model considers the influencing factors of line parameters.
- The probability estimation method is adopted in the identification algorithm.



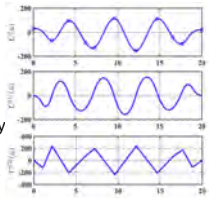
Steps of the DBN-based line impedance estimation model

WePo2_2(9) 15:00-15:30

The Cubic B-spline Trajectories with the Boundary Conditions of Null Velocities and Accelerations

Xingchen Li, Xifeng Gao, Wei Zhang and Lina Hao
School of Mechanical Engineering and Automation, NortheasternUniversity, Shenyang, China

- The pick-and-place operations require velocities and accelerations at the ends.
- A new approach is designed to obtain such null boundary conditions for cubic B-splines.
- The presented approach is robust, structurally simple, and computationally efficient.
- The planned trajectories are smooth, without sudden changes in speed and acceleration.



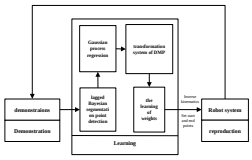
A cubic B-spline trajectory with null boundary conditions

WePo2_2(10) 15:00-15:30

Multi-step Tasks Learning Based on Bayesian Segmentation and Dynamic Movement Primitive

Jianjun Yu, Jie Jia, Guoyu Zuo
Faculty of Information Technology, Beijing University of Technology, Beijing, China
Xuchen Li, Yilin Cao and Zihao Zhang
Faculty of Information Technology, Beijing University of Technology, Beijing, China

- Multi-step task trajectory segmentation based on lagged Bayesian change-point detection algorithm
- Gaussian process regression models multiple demonstrations of a single motion
- Modeling basic motion with dynamic movement primitive



Framework of Imitation Learning

WePo2_2(11) 15:00-15:30

A Novel Hybrid Actuator for The Hand Exoskeleton

Jianyu Yang and Tao Wei,Hui Shi
School of Mechanical Engineering & Automation, Northeastern University, China

- The existing memory alloy-based actuators have the problems of slow response and high energy consumption.
- Proposing a novel hybrid actuator, which combines SMA springs with servo motors. PID control algorithm is introduced in the motion control to make SMA spring output more stable.
- The experiment proves that the dynamic system can meet the motion characteristics of the coupling tendon movement.

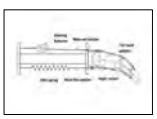


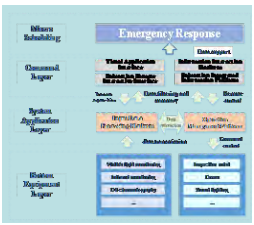
Figure. Hybrid drive system

WePo2_2(12) 15:00-15:30

Design and Development of Multifunctional Management Platform for Substation Considering Application of Intelligent Technologies

Xin Wang and Gongyuan Zhang
Department of Production Technology, Yunnan Power Grid Co., Ltd., China.
Xiaoli Zhu
Power Supply Bureau, Yunnan Power Grid Co., Ltd, China

- This paper proposed an intelligent multifunctional substations management platform with new technologies.
- The initial construction of this platform has been finished in Yunnan Province China.
- This platform can realize intelligent supervision status assessment and risk analysis to substations.
- This platform improved the efficiency of substation management and reduced the human burden.



Platform system architecture

WePo2: Poster Session 2 (cont.)

Room : Grand Ballroom Foyer, 15:00-15:30, Wednesday, July 28, 2021

WePo2_3(13) 15:00-15:30

Design of an Online Monitoring and Analysis Platform for Power Grid Based on Internet of Things

Hongwei Yang and Gongyuan Zhang
Department of Production Technology, Yunnan Power Grid Co., Ltd., China.
Nongtao Zhang
Power Supply Bureau, Yunnan Power Grid Co., Ltd, China

- This paper realized the real-time collection and analysis of system IoT terminal data in the power system.
- This paper developed an online monitoring platform which collecting data by monitoring terminal.
- This platform improved the intelligent level of substation supervision.
- This platform integrates a variety of mature big data processing technologies.

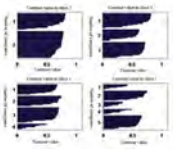
Visual interface of production monitoring command center

WePo2_3(14) 15:00-15:30

Classification Method of Power Users Based on K-means and Support Vector Regression

Li Kun, Yan Shuai, Zhu Kang, Luo Lei, Yao Dongfang, Wu YingChina Southern Power Grid Co., Ltd. EHV Power Transmission Company, Guangzhou 510670, China.

- With the development and improvement of the power market, the role of demand-side resources has been re-recognized and users' willingness to actively participate in the grid interaction has become stronger. Effective research on power user classification is of great significance. Firstly, in view of the possible vacancy problem of load data acquisition, the cubic exponential smoothing method is used to complete the processing. Then, the K-means method is used to realize the load curve clustering, the contour coefficient method is used to determine the cluster category, and the hierarchical clustering method is used to determine the cluster center, so as to improve the K-means clustering effect and reduce the clustering time. Support vector regression is further used for training and learning to obtain the regression value of each input test data. Finally, the effectiveness of the proposed method is verified based on tests of actual examples.



Contour Values for 2, 3, 4 and 5 Categories

WePo2_3(15) 15:00-15:30

High Performance FOG IMU and Algorithm for Railway Dynamic Inspection

Yue Guan
CRRC QINGDAO SIFANG CO., LTD.
Jin He, Xi Fu, Danwei Wang
Chengdu SinoRail Electronics Co.,Ltd

- Cross level: $H = D*\sin(\theta_i)$, θ_i : roll of the bogie, measured by FOG IMU; D: track gauge
- Longitudinal level: calculated by the LACC and RACC (accelerometers to measure carriage motion) ◦
- Track alignment: $Y(x) = \iint a_0 dtdt$
- a0 = a - a_g - a_t- a_r
- a : FOG acceleration; a_g : gravity acceleration;
- a_t : centripetal acceleration; a_r : tangential acceleration

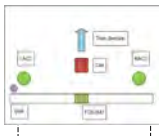


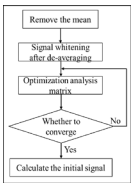
Fig1.Inertial Sensor Installed on the train

WePo2_3(16) 15:00-15:30

ICA and PIND based Remainder Particle Detection Technique for Space-borne Equipment

Qi Zhang
The 54th Research Institute of CETC
Zhishuai Jiang
School of Control Engineering, Northeastern University, China

- Particle impact noise detection (PIND) is usually used to detect remainder particle
- Independent component analysis (ICA) is an effective audio signal separation technique
- The system uses ICA technology to separate PIND sound and environmental noise
- Through many experiments, the accuracy of noise removal through ICA and PIND fusion method reaches 100%



ICA algorithm flow chart

WeR3: SLAM and Navigation

Session Chair: Dong Liu

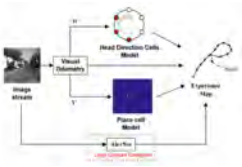
Room : Ramada Grand Ballroom A, 15:30-17:00, Wednesday, July 28, 2021

WeR3(1) 15:30-15:45

Semi-Bionic SLAM Based on Visual Odometry and Deep Learning Network

Dong Liu, Zhi Lyu, Qiang Zou, Xue Bian and Ming Cong
School of Mechanical Engering, Dalian University of Technology, China
Bangyu Li
SIASUN Co., China
Yu Du
Dalian Dahuazhongtian Technology Co., China

- Propose the SB-SLAM which combines visual odometry and biological cells to construct an experience map
- Use AlexNet deep learning network to detect loop closure in the environment
- Test on the KITTI dataset to verify the effectiveness of our method

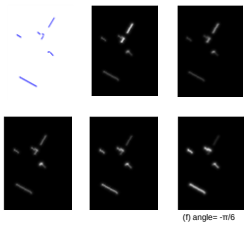


WeR3(2) 15:45-16:00

Improved High-Dimensional Likelihood Field Matching for Mobile Robot SLAM Based on Line-Segment Model

Junjie Xu, Li Liu and Jiwen Zhang
the Department of Mechanical Engineering, Tsinghua University, China

- An efficient SLAM algorithm based on line-segment with high-dimensional likelihood field is proposed.
- An improved high-dimensional likelihood field is constructed based on the multidimensional geometric information of line-segments.
- During the matching process, the line features were discretized into points for matching.



Slices of improved high-dimensional likelihood field with different tilt angles

WeR3(3) 16:00-16:15

An automatic three dimensional markerless behavioral tracking system of free-moving mice

Yaning Han, Kang Huang, Ke Chen,
Liping Wang and Pengfei Wei
Shenzhen Institutes of Advanced Technology,
University of Chinese Academy of Sciences, China

- Develop an 3D markerless behavioral tracking system of free-moving mice
- The system can automatically calibrate the multi-view cameras before 3D reconstruction
- The system can precisely track sixteen 3D body points of mice based on deep learning
- The system can capture more subtle behavior data than traditional method

Schematic workflow of 3D mouse behavior tracking

WeR3(4) 16:15-16:30

An Outdoor GPS Navigation Optimization Method Based On Naïve Bayes Method

YongQuan Dai
SIASUN Robot & Automation CO.,Ltd, China
FengYing Wang
Shenyang Jianzhu University, China

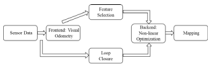
- Naïve Bayes prediction is used to reduce the cost of Path-Broken traveling salesman problem(PBTSP).
- The cost of a single path must consider the pass cost and congestion cost.
- Dijkstra algorithm with comprehensive cost is used to obtain a shortest path in the graph.
- The method is also helpful in other navigation scenes or company merger decisions.

WeR3(5) 16:30-16:45

Feature selection SLAM algorithm incorporating attention and anticipation

Zeng YJ and Jiang Y
the College of Information Science and Engineering, Northeastern University, Shenyang, China. State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences Shenyang, China.

- It can select features that are more likely to remain in the field of view.
- It can discard features that are about to disappear from the field of view.
- The test shows that the algorithm can ensure the accuracy of positioning in complex scenarios.



The whole process

WeA3: Field Robotics

Session Chair: Yong Liu

Room : Juxian A, 15:30-17:00, Wednesday, July 28, 2021

WeA3(1) 15:30-15:45

Adaptive Back-stepping Control of Cross-domain Robot in Water and Ground Environment

Ke Wang, Yong Liu, Chengwei Huang,
School of Computer Science and Engineering,
Nanjing University of Science and Technology, China
Wei Bao
School of Mechanical Engineering,
Nanjing University of Science and Technology, China

- This paper proposed a cross-domain robot(CDR)
- A mathematical model of robot kinematics and dynamics on water and ground environments is established
- A backstepping adaptive control algorithm is proposed for CDR

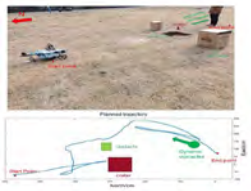
Cross-domain Robot

WeA3(2) 15:45-16:00

Cross-domain Robot Map Building and Planning in Emergencies

Peng Cheng , Yong Liu and Ke Wang
School of Computer Science and Engineering, Nanjing University of Science and Technology,China

- The robot needs to do path planning quickly at the bottom of the controller .
- A method based on multi-sensor data fusion is proposed to construct a real-time map .
- A method combining dynamic window approach (DWA) and safe search strategy is proposed .
- The method used has a high frequency to avoid dangerous conditions .



Emergency path planning

WeA3(3) 16:00-16:15

Modeling and Hybrid Powers Control of Cross-domain Robot on the Water

Chunyan Zhang, Yong Liu, Ke Wang and Zhen Xiao
School of Computer Science and Engineering, Nanjing University of Science and Technology, China

- A cross-domain robot capable of moving in water, land and air environments
- Modeling of the cross-domain robot
- A sliding mode controller based on a disturbance observer

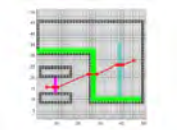
Cross-domain robot

WeA3(4) 16:15-16:30

Three dimensional path planning of cross-domain robot based on improved A* algorithm

Zhen Xiao, Yong Liu*, Chunyan Zhang
School of Computer Science and Engineering,
Nanjing University of Science and Technology, China

- Construct a 2.5-dimensional environment grid map to integrate the environment information
- Design a multi-objective heuristic function based on motion energy consumption and time
- Add the part of the space in the backtracking process
- Path optimization to reduce the redundant path points



Path graph of improved A* algorithm

WeA3(5) 16:30-16:45

Design, Modeling and Simulation of a Reconfigurable Land-Air Amphibious Robot

Zhi-yu Liu, Mei-li Song, Bing Bai
School of Mechanical Engineering,
Nanjing University of Science and Technology, China
Yong Liu
School of Computer Science and Engineering,
Nanjing University of Science and Technology, China

- This paper proposed a reconfigurable land-air amphibious robot
- Analyzed the movement principle of the robot and established its dynamic model
- The virtual prototype of the robot was established and the dynamics simulation was carried out
- The theoretical results and simulation results mutually verify the correctness

Different modes of the amphibious robot

WeB3: Intelligent Sensing and Control

Session Chair: Lingli Yu

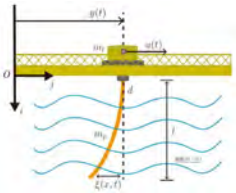
Room : Jude B, 15:30-17:00, Wednesday, July 28, 2021

WeB3(1) 15:30-15:45

Adaptive Neural Network Control for Underwater Flexible Crane Systems

Yue Wang, Ning Sun, Tong Yang, Zhuoqing Liu, and Yongchun Fang
Institute of Robotics and Automatic Information Systems (IRAIS), College of Artificial Intelligence; Tianjin Key Laboratory of Intelligent Robotics (tjKLIR), Nankai University, China

- Although the original dynamic model of underwater flexible crane system is very complex, this paper does not simplify or linearize it.
- The proposed method can make the underwater flexible crane system achieve established goals, ensure the accurate and fast positioning of the trolley, and effectively suppress the transverse vibration of the flexible payload.



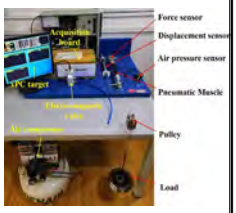
Underwater flexible crane system

WeB3(2) 15:45-16:00

Prescribed Performance-based Chattering-free Tracking Control for Pneumatic Muscle Actuators

Yu Cao, Jian Huang and Mengshi Zhang
School of Artificial Intelligence and Automation, Huazhong University of Science & Technology, China

- A proxy-based prescribed performance tracking control for pneumatic muscle actuators.
- The proxy is regarded as a buffer between the desired trajectory and the controller object.
- The system tracking errors are proven to be global ultimately uniformly bounded.
- Experimental results indicates the PMA trajectory is constrained into a pre-set bound.



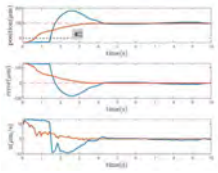
PMA Platform

WeB3(3) 16:00-16:15

Automated Micropipette Aspiration and Positioning with an Auxiliary Micropipette

Yatong Yao, Mingzhu Sun, Xiangfei Zhao, Lu Li, Huiying Gong, Xin Zhao
the Institute of Robotics and Automatic Information System (IRAIS), Nankai University, Tianjin 300350, China.

- The flow field provided by the auxiliary micro-pipette reduces the adhesion between the microbead and the bottom of the petri dish.
- The position information of the pipette tip and microbead, extracted via image processing.
- A dynamic model of the motion of the micro-bead in the pipette is established and a sliding mode controller is designed on this basis.
- The experimental results show that the pro-posed method has faster stability time, smaller steady-state error and higher success rate com-pared with the traditional aspiration method.



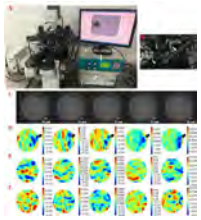
Results of experiment

WeB3(4) 16:15-16:30

Intercellular Movement Tracking for Damage Assessment During Cell Micromanipulation

Yizhe Chen, Yue Du, Yaowei Liu, Qili Zhao, Mingzhu Sun, and Xin Zhao
The Institute of Robotics and Automatic Information System (IRAIS) and the Tianjin Key Laboratory of Intelligent Robotic (tjKLIR), Nankai University, China
Maosheng Cui
The Institute of Animal Science and Veterinary of Tianjin, China

- We designed a quantitative marker to characterize cell mechanical damage during the penetration.
- The high-strain damage with a strain threshold of 0.02 is intensified as penetration proceeds.
- The measurement error of the maximum intercellular displacement was reduced from 0.294 to 0.065.



WeB3(5) 16:30-16:45

Thermal error analysis and compensation in structured light system by virtual-point-based method

Chenwei Hsu, Gang Rao, Chengye He, Jing Xu
Mechanical Engineering, Tsinghua University, China

- Decreasing measurement accuracy of structured light system caused by variation in non-constant temperature workshop.
- Thermal error model of structured light system is analyzed, and verified by simulation and experiment.
- Virtual points are added into the traditional method to improve the compensation efficiency.
- Obtained the relationship between parameters and temperature.

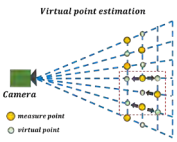


Figure Use virtual points to increase calibration information

WeB3(6) 16:45-17:00

Robust place recognition based on multi-sensor fusion

Hao Gu* and Zhihui Wang, Ning Yin
school of Computer Science and Engineering, Nanjing University of Science and Technology, China

- Introduction and related work
- Point cloud projection descriptor
- Place recognition

Thursday Sessions

ThPo3: Poster Session 3

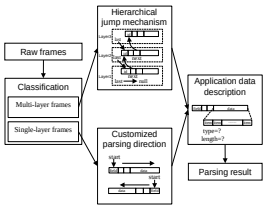
Room : Grand Ballroom Foyer, 10:40-11:00, Thursday, July 29, 2021

ThPo3(1) 10:40−11:00

Self-adaptive resolution method for multiple industrial communication protocols

Fanyu Meng, Mingzhe Liu, Aidong Xu,
Ni Jin and Jingran Wang
Shenyang Institute of Automation, Chinese Academy of Sciences, China

- Propose single-layer frames and multi-layer frames to classify industrial communication protocols
- Use hierarchical jump mechanism to describe the relationship of each layer
- Set the “direction” attribute to describe the parsing direction
- Describe the length and type of each application data item



Protocol resolution architecture

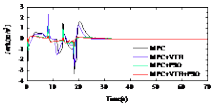
ThPo3(2) 10:40−11:00

Research on Vehicle Multi-Objective Adaptive Cruise Control System Based on Particle Swarm Optimization Algorithm

Chunguo Zhou ,Ning Qiao, Jin Mao, Chenxi Zhao and Lei Yang

School of Mechanical and Precision Instrument Engineering, Xi'an University of Technology, China

- The vehicle ride comfort can be expressed by Jerk
- (MPC+VTH+PSO) is the algorithm which combines the VTH strategy and PSO algorithm
- The algorithm with PSO algorithm performs better
- (MPC+VTH+PSO) improves the comfort and fuel economy of ACC system.



Simulations under steady scenario

ThPo3(3) 10:40−11:00

Construction and application of public building virtual generator based on multiple nonlinear regression

Bing Wang, Lin Cong, Na Li, Nan Wang, Xichao Zhou
State Grid Integrated Energy Service Group Co. Ltd, China
Jianyong Ding, Ciwei Gao
School of Electrical Engineering, Southeast University, China

- The power of central air-conditioning system is affected by outdoor temperature and humidity
- The maximum output power of the virtual generator decreases with the increase of outdoor temperature
- The virtual generator with low temperature consumption under same output power should be dispatch first

ThPo3(4) 10:40−11:00

Characteristics Study on Respiratory Movement of Chest and Abdominal Surface Area for Respiration Tracking in Radiosurgical Robots

Shumei Yu, Bo Li, Jiateng Wang, Rongchuan Sun, Lining Sun
the school of mechanical and electrical engineering,
Soochow University, China

- A new respiratory motion representation method based on chest and abdominal surface area is proposed.
- Point cloud data of chest and abdominal surface during breathing movement is collected and processed.
- The processed point cloud data is used to reconstruct the chest and abdominal surface.
- The surface area showed the characteristics of respiratory fluctuation on the whole in the time series.

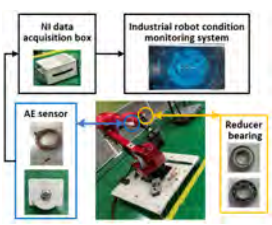
Flow chart of chest and abdomen area extraction

ThPo3(5) 10:40−11:00

Health assessment method of industrial robot reducer based on deep belief network

Chengcheng Ji and Kai Wang
Shenyang Institute of Automation, Chinese Academy of Sciences, China
Decheng Yuan
Shenyang University of Chemical Technology, China

- A deep-level probability directed graph model-Deep Belief Network is used to assess health status for industrial robot reducer in this paper.
- The Deep Belief Network adopts constrained Boltzmann machine for layer-by-layer pre-training, and back propagation algorithm for weight optimization.
- The diagnosis performance of deep belief network is compared with that of back propagation neural network.
- The condition monitoring system of industrial robot is established to collect data.



ThPo3(6) 10:40−11:00

Adaptive Obstacle Avoidance Optimization Algorithm Based on Learning from Demonstration

W.Li and XH. Zhang
Faculty of Electronic Information & Electrical Engineering Dalian Univ. of Tech., China
HT. Cheng Z.Liang and JC.X
School of Mechanical Engineering and Automation, Northeastern Univ., China

- Abandoned linkage collision dataset

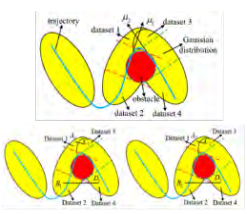
Implement the linkage-based obstacle avoidance algorithm

- The obstacle collides with 2 Gaussian

The eigenvalue decomposition of the Gaussian ellipse closest to the obstacle yields

- Filtering Optimization.

Remove collision and invalid data for obstacle avoidance



ThPo3: Poster Session 3 (cont.)

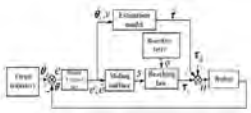
Room : Grand Ballroom Foyer, 10:40-11:00, Thursday, July 29, 2021

ThPo3_2(7) 10:40−11:00

Fast-terminal sliding mode control based on dynamic boundary layer for lower limb exoskeleton rehabilitation robot

Sheng-Bin Cao, Guang-Zhong Cao, Yue-Peng Zhang, Zi-Qin Ling, Bin-Bin He and Su-Dan Huang
Guangdong Key Laboratory of Electromagnetic Control and Intelligent Robots, Shenzhen University, China

- Design the compensation term of the control law based on the fast-terminal sliding mode surface and the double power reaching law.
- Design a dynamic boundary layer to suppress the chattering of the system state.
- Carry out the co-simulation based on the virtual prototype of LLERR.



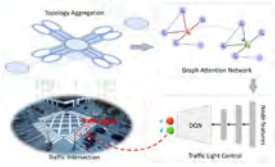
The control block diagram

ThPo3_2(8) 10:40−11:00

Graph Topography-Aware Reinforcement Learning for Intelligent Traffic Signal Control

Chao Yang, Bo Zou, Wenbing Huang, Fuchun Sun, Huaping Liu
Department of Computer Science and Technology, Tsinghua University, Beijing

- A new road network representation method based on graph attention network.
- A graph topography-aware reinforcement learning for adaptive traffic signal control.
- A realistic traffic intersection environment on a vehicle simulation platform.
- The considerable empirical results on intersection traffic signal control.



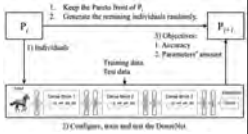
A graph-based reinforcement learning framework for adaptive traffic signal control

ThPo3_2(9) 10:40−11:00

Convolutional Neural Network Optimization Using Modified NSGA-II

Zhidong Su and Weihua Sheng
School of Electrical and Computer Engineering, Oklahoma State University, USA
Senlin Zhang
State Key Laboratory of Industrial Control Technology, Zhejiang University, China

- The accuracy and inference speed should be considered when deploying DNNs to embedded devices.
- NSGA-II can be used to generate a set of optimal DNNs.
- A modified NSGA-II was proposed to speed up the training process.
- The modified NSGA-II achieved similar results as NSGA-II and saved 46.20% of the training time.



ThPo3_2(10) 10:40−11:00

Research on Solar Radiation Estimation Based on Singular Spectrum Analysis-Deep Belief Network

Qianqian Xia, Haixiang Zang, Ling Liu, Xin Jiang and Zhinong Wei
College of Energy and Electrical Engineering, Hohai University, China

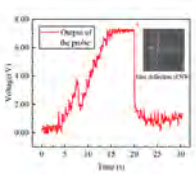
- Consider air pollution parameters as input
- Use the maximum correlation minimum redundancy algorithm to select the input
- Establish a daily solar radiation estimation model based on singular spectrum analysis-deep belief network

ThPo3_2(11) 10:40−11:00

In Situ Measurement of the Kinetic Friction of Si Nanowires on SiC Substrates in SEM with a Microprobe

Peng Gao[1], Jie Zhou[2], Tao Zou[1], Weibin Rong[1]*
[1]State Key Laboratory of Robotics and Systems, Harbin Institute of Technology, China
[2]School of Electrical and Control Engineering, Heilongjiang University of Science and Technology, China.

- The total kinetic friction force was measured by the micro-force probe.
- The thermal insulation connector is used to avoid the influence of temperature.
- The Faraday cup was used to measure the surface current to minimize the charging effect.
- The high sensitivity of the micro-force probe is used to eliminate the pre-load force.



The curve of the tangential fore applied on the Si NW.

ThPo3_2(12) 10:40−11:00

Salient Target Detection in RGB-T Image based on Multi-level Semantic Information

Ziwei Wu
College of Information Science and Engineering, Northeastern University, China
Tong Jia
College of Information Science and Engineering, Northeastern University, China
Yunhe Wu
College of Information Science and Engineering, Northeastern University, China
Feng Liang
College of Information Science and Engineering, Northeastern University, China

- salient target detection
- RGB-T
- end-to-end network
- deep learning

ThPo3: Poster Session 3 (cont.)

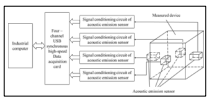
Room : Grand Ballroom Foyer, 10:40-11:00, Thursday, July 29, 2021

ThPo3_3(13) 10:40−11:00

Detection System of Remainder Particle for Space-borne Electronic Equipment Based on PIND

Zhishuai Jiang
Northeastern University at Qinhuangdao, China
Yuliang Zhao
Northeastern University at Qinhuangdao, China

- Particle impact noise detection (PIND) is usually used to detect remainder particle
- The remainder particle by combining time domain features and frequency domain features
- Through many experiments, the accuracy of the system can reach 100% by this method



The system uses PIND to detect remainder particles

ThPo3_3(14) 10:40−11:00

Decomposition Method of Power Communication Optical Network Based on Optimal Resource Adaptation

Yaping Li, Peng Xie, and Zhijun Zhang
State Grid Xinjiang Electric Power Company, China
Wei Tai
Nanjing Dongbo Smart Energy Research Institute, China

- This paper presents the decoupling principle and simulation interaction architecture of physical system and information system.
- The cyber physical power network is decomposed, reused, and managed through unified centralized management.
- The utilization of communication network resources can be strongly promoted.

Overall architecture of the cyber-physical system joint simulation platform

ThPo3_3(15) 10:40−11:00

Research on the Application Mode of Security Defense Service of the Closed-source Power Industrial Control System

Xiangqun Wang and Xiaojian Zhang
Global Energy Interconnection Research Institute Co. Lt, China
Zhimin Guo, Zhuo Lv and Wen Yang
State Grid Henan Electric Power Research Institute, China

- This paper studies the basic security defense architecture for the power industrial control system.
- The defense architecture and business architecture based on the “cloud-network-terminal” mode is put forward.
- Back door embedded detection system to meet the "cloud-network-terminal" ollaborative defense is developed.

Communication network among the power industrial system

ThPo3_3(16) 10:40−11:00

Recognition of insulator based on yolov5 algorithm

Feng Han, Jiang Yong
Shenyang Institute of Automation Chinese Academy of Sciences,China

- Use yolov5 to identify insulator strings.
- Use a small amount of data to train the network
- Compare the performance differences between the four models

detection result of yolov5

ThR1: Best Paper Session 2

Session Chair: Xingang Zhao

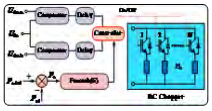
Room : Ramada Grand Ballroom A, 11:00-12:30, Thursday, July 29, 2021

ThR1(1) 11:00-11:15

Research on Fault Ride Through Strategy of Multi-terminal HVDC Considering Offshore Wind Clustering Effect

Qian Wu, Xin Bo, Shan Song
Economic Research Institute, State Grid Jiangsu Electric Power Co. Ltd., China
Zhichao Yang, Zeyu Cao, Bingtuan Gao
School of Electrical Engineering, Southeast University, China

- To deal with energy surplus in HVDC during DC fault, a FRT strategy is proposed.
- The FRT strategy adopts distributed DC chopper which can absorbs surplus energy.
- DC chopper is determined by wind clustering characteristics and supporting capacity of VSC converter.
- Simulation verifies that the strategy can ensure fast recovery of offshore wind power via HVDC.



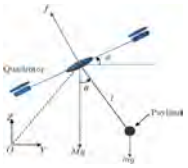
FRT strategy based on distributed DC chopper

ThR1(2) 11:15-11:30

Time-optimal Planning for the Quadrotor Transportation System Landing a Payload on the Mobile Platform

Xiao Liang, Jinjiang Gao, Jianda Han,
Institute of Robotics and Automatic Information System, Tianjin Key Laboratory of Intelligent Robotics, Nankai University, Tianjin 300350, China

- The dynamic model of the system is obtained by Lagrange's method.
- A time-optimal planning problem is constructed to land a payload on the mobile platform.
- Various constraints are taken into account, including payload antiswing, obstacle avoiding.
- Simulation results show that the algorithm performs well.



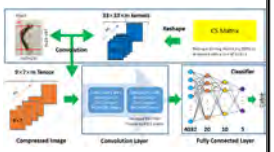
Dynamic model of the planer quadrotor transportation system

ThR1(3) 11:30-11:45

Object Recognition Using Learning-based Compressive Sensing

Zhengyang Du, Congjian Li, Xiaobin Zhang and Ning Xi
Department of Industrial and Manufacturing Systems Engineering, The University of Hong Kong, China

- An object recognition algorithm which directly uses compressed image signals as the input is proposed
- A dataset which contains 15300 images of 5 types of cables is constructed
- Experiments are conducted in two datasets to evaluate the performance of the proposed method



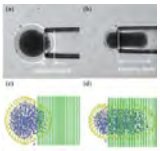
The structure of object recognition network

ThR1(4) 11:45-12:00

Computational Modeling of Subcellular Structures For Studying Mechanical Properties

Shuai Zhang, Yue Du, Yaowei Liu, Qili Zhao, Xin Zhao
Institute of Robotics and AutomaticInformation System,
Nankai University, China

- We propose a method to develop a subcellular model of eukaryotic cells.
- The model explicitly takes into account the mesoscopic structure of cell membrane, cytoskeleton.
- The micropipette suction phenomenon in the low-speed flow was well simulated.
- The large cell deformation phenomenon in the high-speed flow field was also well simulated.



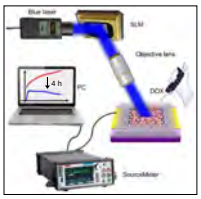
Micropipette sucking phenomenon.

ThR1(5) 12:00-12:15

A Pharmacodynamic Evaluation Method Based on Optogenetics and Graphene FETs

Jia Yang[1,2,3], Lipeng Zu[1,2,3], Dan Dang[4], Mengyue Li[1,2,3], Wenxue Wang[1,2,*]
[1]State Key Laboratory of Robotics, Shenyang Institute of Automation,
[2]Institutes for Robotics and Intelligent Manufacturing, Chinese Academy of Sciences, China
[3]University of Chinese Academy of Sciences, China
[4]Faculty of Medical Devices, Shenyang Pharmaceutical University, China

- A novel method for pharmacodynamic evaluation based on optogenetics and GFETs was proposed;
- The time-dependent increment in the photoinduced output of the GFET fused with engineered cancer cells was used for efficacy evaluation.
- The proposed method is easy handling and efficient.

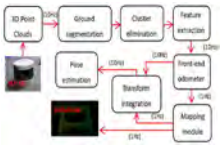


ThR1(6) 12:15-12:30

A robust and efficient mapping and positioning system

Zhi Hua
Shenyang Institute of Automation, Chinese Academy of Sciences University, China
Jilai Song, Zhenjun Du, Mingmin Liu,Jingtao Hu
SIASUN Robot & Automation Co, Ltd, China

- The real-time mapping and localization (SLAM) framework includes front-end optimization and back-end closed-loop detection.
- A random sampling consensus algorithm is used for ground segmentation,
- We add ground constraints in the registration to prevent map form bending.
- An improved text scanning algorithm is used to optimize the back-end pose.



The SLAM system includes Front-end optimization and back-end detection

ThR2: Sensing and Recognition

Session Chair: Wenxue Wang

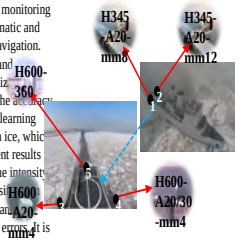
Room : Ramada Grand Ballroom A, 13:30-15:00, Thursday, July 29, 2021

ThR2(1) 13:30-13:45

The Multi-Parameter Monitoring Method of Sea Ice Based on Image Processing Technique

Kaixuan Tian[1],Zhiqiang Liu[1], Lianjiang Li[1] , Ning Zhou[1] , Yuliang Zhao[1,*], *IEEE Member*

Periodic sea ice is generated every winter seriously affects the safety of navigation and maritime operations in the high latitude sea areas. However, the current monitoring techniques could not detect the basic sea ice physical parameters in an automatic and accurate way, which is far away from the needs of marine production and navigation. At present, the most used sea ice monitoring methods based on naked eyes and equipment are time-consuming and labor-expensive. While the methods utiliz satellite remote sensing and radar observation station are highly limited by the ac and cost. In this paper, a method integrating image processing and machine learning technologies is proposed to automatically obtain the multi-parameters of sea ice, whic include sea ice thickness, density, size distribution, and types. Our experiment results show that the average measurement error of thickness was less than 4 cm, the intensit was 2.8%, the size distribution was 5.8%, and the accuracy rate of type classi was 95%. This method has the advantage of easy operation, high precision, an cost, which can greatly reduce the risk of manual operation and observation errors. It is expected to become the main method of sea ice monitoring.

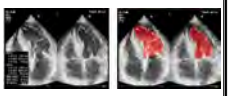


ThR2(2) 13:45-14:00

A new method of heart target region recognition based on dense pixel features

Weibo Song
School of Control Science and Engineering, Dalian University of Technology
Fengjiao Jiang and Kaiyan Zhu
College of Information Engineering, Dalian Ocean University, China

- A method of cardiac function analysis based on echocardiography and semantic segmentation is proposed.
- Pixel level semantic segmentation of left ventricular region is performed on apical four chamber echocardiography images with end diastolic and end systolic characteristics.
- The segmentation results can be used to calculate various parameters of the left ventricle in different periods, and realize the auxiliary analysis of cardiac dynamic function.



Comparison of recognition results between Ultrasonic instrument and TDEcho-FCN

ThR2(3) 14:00-14:15

Visual Detection of Cells in Brain Tissue Slice for Patch Clamp System

Yuxin Ma, Yunyao Cai and Zeyu Wang
College of Artificial Intelligence, Nankai University, China
Mingzhu Sun and Xin Zhao
Institute of Robotics and Automatic Information System (IRAIS) and the Tianjin Key Laboratory of Intelligent Robotic (tjKLIR), Nankai University, China

- Visual Detection of Cells in Brain Tissue Slice under View of Differential Interference Contrast (DIC) Microscope
- Image Classification Based On Image Clarity
- Visual Detection of Neurons in Brain Tissue Slice Based on Machine Learning

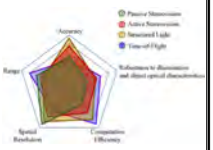
Fig. Cell detection result. The detected cells are labelled by red boxes.

ThR2(4) 14:15-14:30

Comparative study on 3D optical sensors for short range applications

Rui Chen and Jing Xu
Department of Mechanical Engineering, Tsinghua University, China

- For measurement of static objects under weak and normal illumination, temporally-encoded PSP is preferred.
- For measurement of dynamic objects or under strong illumination, IR stereovision is preferred.
- For texture-less surfaces, passive stereo sensor should not be used.
- Existing depth sensing technologies still cannot measure transparent objects accurately and completely.



ThR2(5) 14:30-14:45

Control of SEA Modular Joint for Rehabilitation Exoskeleton Based on Modified Model Predictive Control

Wanxin Chen, Bi Zhang, Jie Yao, Xingang Zhao
State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, China

- A compact and light weight SEA modular joint with linear/non-linear stiffness switching mechanism is proposed.
- The iterative linearization MPC is given to solve the nonlinear optimization problem under several constraints.
- The modification of cost function achieves prescribed degree of stability by assigning the closed-loop eigenvalues to preset circle.
- Some simulation results are given to prove the effectiveness of the proposed method.

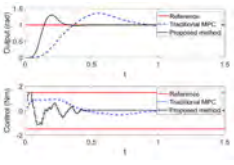


Fig.1 Output and control with/without prescribed degree of stability

ThA2: Power Systems

Session Chairs: Yi Tang and Lixia Sun

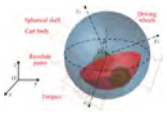
Room : Juxian A, 13:30-15:00, Thursday, July 29, 2021

ThA2(1) 13:30-13:45

Co-Simulation of Two-Wheel Differential Spherical Robot Based on ADAMS and MATLAB

Yuanyi Tang, Jiahong He and Bingtuan Gao
School of Electrical Engineering, Southeast University, China
Jun Liu, Tao Yang and Kui Xu
Department of Science and Information, Electric Power Research Institute, Guizhou Power Grid Company Ltd., China
Ji Liang
Department of Transmission and Distribution, Liupanshui Zhongshan Electric Power Company, Guizhou Power Grid Company Ltd., China

- Design of two-wheel differential spherical robot (TWDSR) for power cable tunnels environment monitoring.
- Kinematics and dynamics characteristic of TWDSR are simulated and analyzed in ADAMS.
- Co-simulation based on ADAMS and MATLAB to design the controller of TWDSR.



Mechanical structure of TWDSR

ThA2(2) 13:45-14:00

Propagation and Distribution Characteristics of Subsynchronous Oscillation in Power Grid

Biao Jin
College of Energy and Electric Engineering, Hohai University, China
Yiping Yu
College of Energy and Electric Engineering, Hohai University, China

- Proposes a new time-domain simulation method
- Verifies method accuracy in a single-machine infinite bus system
- Exploring the Influence of Frequency on Subsynchronous Oscillation Propagation
- Exploring the Influence of Electrical Distance on Subsynchronous Oscillation Propagation

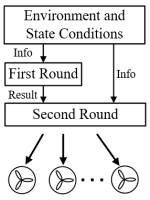
Propagation Distribution of SSO in System

ThA2(3) 14:00-14:15

Research on Active Power Command Allocation of the Wind Farm Considering Multiple Uncertainties

Kaiyuan Huang and Yi Tang
School of Electrical Engineering, Southeast University, China
Junjie Feng, Changyue Zou and Xiaobin Zhao
State Key Laboratory of HVDC, Electric Power Research Institute, China Southern Power Grid, China

- The active power adjustment time of wind farm is limited under national standard.
- The adjustment suffers from uncertain factors like wind speed, communication problems, etc.
- The multi-round allocation strategy is proposed and should meet the constraints.
- The strategy verified by simulation can improve the active power regulation capability.

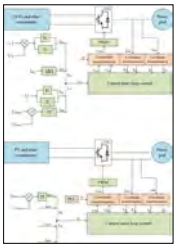


ThA2(4) 14:15-14:30

A General Fault Ride Through Control Model for Typical Renewable Energy Generators

Yeting Han, Zhengyang Hu, Zhichao Yang, Bingtuan Gao,
Electrical Engineering, Southeast University, China
Fangwei Duan, Wei Fan
State Grid Liaoning Electric Power Research Institute, China

- Inverter-interface renewable energy sources, such as photovoltaic and wind generations, has been becoming main power suppliers in modern power system.
- By investigating control models of typical renewable generators, this paper proposes a general FRT control mode for renewable generators, and present detailed control diagram and logics of the general control mode.
- The simulation results verify that the proposed general FRT control mode can adapt to analysis of typical renewable generators during faults successfully.



ThB2: Automaton in Pavement and Bridge

Session Chairs: Guojin Tan and Wensheng Wang

Room : Jude B, 13:30-15:00, Thursday, July 29, 2021

ThB2(1) 13:30-13:45

•Autonomous Bridge detection based on ResNet for multiple damage types

Guojin Tan and Zheng Yang
Transportation Department, Ji Lin University , China

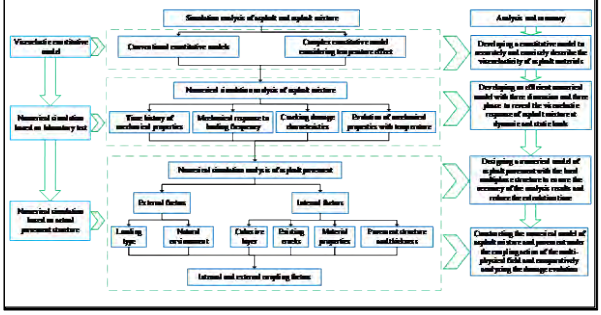
- **Fast, simple, high-accuracy way to detect bridge damage.**
- **Framework based on ResNet-101 model and transfer learning method.**
- **Damage dataset with 2,726 images including crack, spall, rebar exposed and honeycomb.**
- **Higher performance than traditional convolution neural network**

Bridge damage detectable

ThB2(2) 13:45-14:00

Study on numerical simulation of asphalt mixtures and asphalt pavement based on finite element software: A Review

Liding Li, Chunli Wu, Yongchun Cheng, Guojin Tan and He Li
Transportation Department, Jilin University, China



ThB2(3) 14:00-14:15

Study on the Correlation between Surface Resistivity and Rapid Chloride Permeability of Concrete

Wensheng Wang and Hexiang Lei
College of Transportation, Jilin University, China

- Surface resistivity of concrete specimens was measured by quadrupole equidistant method.
- Resistance to chloride ion penetration of concrete was tested using rapid chloride permeability test.
- The correlation between surface resistivity and rapid chloride permeability was further discussed.
- It is of significance for engineering quality control and non-destructive testing.

Rapid chloride permeability test

ThB2(4) 14:15-14:30

Study on properties of rubber-basalt fiber modified concrete based on orthogonal test method

Li Fayang and Zou Lin
School of Transportation, Jilin University, China
Hao Xingyao and Zhao Hongxia
School of Transportation, Jilin University, China

- Modification of composite concrete by rubber particles and basalt fiber.
- To determine the optimum incorporation parameters of the mechanical properties of the modified concrete.
- To study the influence rule of the size of basalt fiber and rubber particles on the performance of concrete.
- To define the conspicuousness of incorporation parameters on mechanical properties of modified concrete.

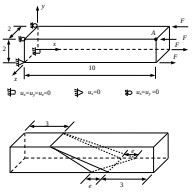
Figure.1 experimental method

ThB2(5) 14:30-14:45

An 8-node Hexahedral Incompatible Element with High Distortion Tolerance

Pei-Lei Zhou
Transportation Department, Ji Lin University , China

- **An 8-node hexahedral incompatible element OCH8 is constructed based on the principle of minimum potential energy.**
- **The basic displacement field and internal parameter displacement field are both expressed by the 3D local oblique coordinate.**
- **The new element can keep high precision for various severely distorted meshes even when four nodes on the element plane are not coplanar.**



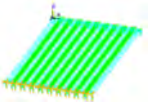
Pure bending test

ThB2(6) 14:45-15:00

Supports Damage Identification of Slab Bridge Based on Modal Curvature Difference Method

Qin Xuxi and Gu Zhengwei
School of Transportation , Jilin University, China
Qin Weijun
Jilin Provincial Transport Scientific Research Institute Changchun Jilin, China

- The curvature mode difference is used as the dynamic fingerprint to identify the damage of bridge support.
- The finite element model is taken as an example for an ordinary slab bridge considering the structural characteristics.
- The results show that the modal curvature difference can be used to identify the bearing support damage.



Beam model of FEM

ThR3: Perception and Recognition

Session Chairs: Zhun Fan and Shuang Liu

Room : Ramada Grand Ballroom A, 15:00-16:30, Thursday, July 29, 2021

ThR3(1) 15:00-15:15

Automatic Drug Box Recognition Based on Depth Camera

Changzheng Zhang and Qiaoyang Xia and Shenghao Li and Simeng Zhong and Shuang Liu
School of Mechanical and Power Engineering, ECUST, China

- Image segmentation using depth camera and computer vision
- Image classification using ensemble learning network
- Image re-segmentation using SR-CNN
- The final recognition result is obtained, and the accuracy is more than 97%

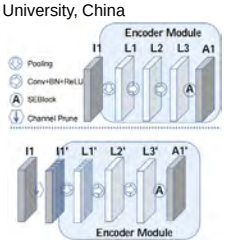
Drug Box Recognition

ThR3(2) 15:15-15:30

Slimming Convolutional Neural Networks Based on Attention Mechanisms for Pavement Crack Detection

Wennig Huang, Guijie Zhu, Zhun Fan*, Wenji Li, Yibiao Rong, Yuwei Cai
College of Engineering, Shantou University, China

- 1) A novel channel pruning method based on channel attention is applied in pavement crack segmentation.
- 2) It pruned about 40% of parameters of UNet architecture with slight drop in performance.
- 3) The feasibility of the proposed method is verified by ablation studies on two public datasets.



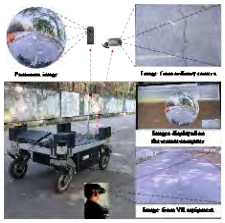
Channel pruning in encoder module

ThR3(3) 15:30-15:45

Road Crack Acquisition and Analysis System Based on Mobile Robot and Deep Learning

Guijie Zhu, Zhun Fan*, Peili Ma, Wenning Huang, Zhihao Ye, Mingwei Huang, Jiangli Li, Zhicheng Jiang, Zhuwei Zhong, and Weiyuan He
College of Engineering, Shantou University, China

1) A framework of road crack acquisition and analysis system is proposed.
2) A crack image dataset with five types of cracks is constructed by manual annotation.
3) An ensembled DCNN model is used to identify and segment the acquired crack images.
4) An image processing method is proposed to analysis the crack information.



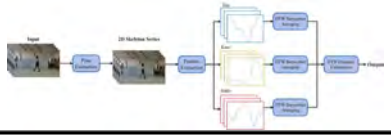
Mobile robot collects crack images on campus road.

ThR3(4) 15:45-16:00

A Video-based Method for Assessment of Hip-Knee-Ankle Coordination during Walking

Yuchen Yang[1,2], Peipei Liu[3], Ting Song[1,2], Yang Yu[4], Jialing Wu[3,4], Jianda Han[1,2], and Ningbo Yu[1,2*]
[1] College of Artificial Intelligence, Nankai University, China
[2] Tianjin Key Laboratory of Intelligent Robotics, Nankai University, China
[3] Department of Neurology, Tianjin Huanhu Hospital, China
[4] Department of Neurorehabilitation, Tianjin Huanhu Hospital, China

- Coordination of lower limb joints during walking is an important indicator for diagnosis and rehabilitation of nervous and musculoskeletal diseases.
- Based on DTW and DBA , a novel method was proposed to quantify the coordination of hip-knee-ankle joints during walking with 2D videos.
- Experiments were conducted with 20 subjects and validated the method.

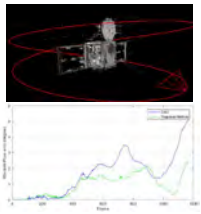


ThR3(5) 16:00-16:15

State and Shape Estimation of Non-cooperative Targets Based on Kinematic Model and DSO

Xunlei Shi, Jiwen Zhang, Chen Liu, Hao Chi and Ken Chen
Department of Mechanical Engineering, Tsinghua University, China

- A real-time reconstruction and state estimation algorithm of completely unknown non-cooperative targets
- Comprehensive use the kinematic model of non-cooperative target and direct visual odometry method
- Use Unity 3D for simulation experiment and verification
- Improve the accuracy and efficiency of state estimation and reduce the noise of reconstruction



ThA3: Intelligent Energy Systems

Session Chairs: Ciwei Gao and Qi Wang

Room : Juxian A, 15:00-16:30, Thursday, July 29, 2021

ThA3(1) 15:00-15:15

Evaluation of Demand Response Effectiveness Based on Edge Computing

DAI Chengcheng, LIAO Minle, FAN Gaosong, MEI Mingshun, LI Hualin, HUANG Chongyang
Chongzuo Power Supply Bureau of Guangxi Power Grid Co., Ltd.

The calculation of demand response user baseline load is a prerequisite for the development of demand response effect evaluation work.

This paper summarizes the commonly used demand response baseline determination methods and proposes a new idea of baseline for parameter identification using the harmony search algorithm.

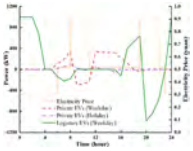
This is a combination of similar day algorithm and intelligent algorithm which ensures both the prediction accuracy and the computational speed. The cases validates the effectiveness of the proposed algorithm.

ThA3(2) 15:15-15:30

Day-Ahead Operation of EV Charging Station in a Logistics Center Considering Charging Behaviors of Different Types of EVs

Jingping Zhang, Ying Wang, Jiaxu Li, and Yin Xu
School of Electrical Engineering, Beijing Jiaotong University (BJTU), China

- An optimal day-ahead operation for the EVCS in the logistics center is proposed.
- The charging behaviors of private EVs and logistics EVs on weekdays and holidays are considered.
- EVs contribute to the cost reduction of the EVCS by joining the V2G service.
- Coordination of the charging schedule of different types of EVs is analyzed.



The charging and discharging power of EVs on typical days with the TOU electricity price

ThA3(3) 15:30-15:45

A Novel Modeling Method for Multi-Regional Flexible Load Aggregation based on Monte Carlo Method

Lin Wang, Yunfei Dong, Nan Liu
State Grid Beijing Electric Power Company, China
Xinyu Liang, Jingwen Yu, and Xiaobo Dou
Southeast University, China

- Double aggregations of the flexible loads based on their mathematical model
- Day-ahead optimal scheduling considering flexible load aggregation model
- Simulation carried out in the setting of a regional integrated energy system(RIES)
- The proposed method makes it convenient for centralized control and shows better peak-shaving ability

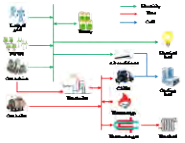


Fig. Structure of regional integrated energy system

ThA3(4) 15:45-16:00

Research on Short-term Power Load Forecasting Based Graph Computation

Shuqi Chen
School of Electrical Engineering, Southeast University, Nanjing, China

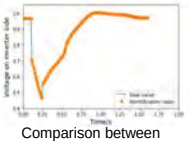
- A dynamic Bayesian network is built as a short-term load forecasting model.
- The parallel computing operators of Apache Spark is used to calculate the parameters of the model.
- The Pregel computing model is used to parallelize the forward backward algorithm.
- High prediction accuracy and fast calculation speed.

ThA3(5) 16:00-16:15

Parameter Identification of HVDC Transmission System Model Based on Intelligent Optimization Algorithm

Jing Zhang
School of Chien-Shiung, Southeast University, China
Jiawen Song, Jianxiong Hu, and Qi Wang
School of Electrical Engineering, Southeast University, China
Chang Su
School of Instrument Science and Engineering, Southeast University, China

- propose a parameter identification method of HVDC system suitable for off-line scenarios
- use PSO to identify the dominant parameters of HVDC system
- can accurately identify the model parameters of the HVDC transmission
- HVDC transmission system model; Parameter identification, Intelligent optimization algorithm.



Comparison between identification response curve and actual response curve

ThB3: Sustainable Energy Systems

Session Chairs: Bingtuan Gao and Hongtai Cheng

Room : Jude B, 15:00-16:30, Thursday, July 29, 2021

ThB3(1) 15:00-15:15

Improved Extinction Angle Control for Subsequent Commutation Failure Mitigation

Quanquan Wang and Bailiang Liu
Jiangsu Economic Research Institute, China
Chenyi Zheng, Rui Gu, Yurong Wang, and Yi Tang
Electrical Engineering, Southeast University, China

- Voltage harmonics are taken into consideration for the extinction angle prediction.
- Prediction result is introduced into the original constant extinction angle control.
- Response speed and control precision of the constant extinction angle control are improved.
- Subsequent commutation failures are mitigated owing to the improved extinction angle control.

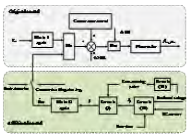


Diagram of the improved extinction angle control

ThB3(2) 15:15-15:30

Modeling and Analysis of Gas-thermal Inertia in the Integrated Energy System

Cairan Miao, Qi Wang and Weijia Sun
School of Electrical Engineering, Southeast University, China

- Research on gas-thermal inertia in the Integrated Energy system
- The validation of gas-thermal inertia and the introduction to their power supporting characteristics
- Case study of the standby configuration considering gas-thermal inertia in the Integrated Energy System

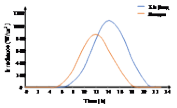
Figure 1. IES park structure

ThB3(3) 15:30-15:45

Modeling of Photovoltaic Power Station Considering the Geographic Factors

Jianping Song, Qiufang Zhang, Jiameng Gao and Yin Xu
School of Electrical Engineering, Beijing Jiaotong University, China
Guixing Yang, Heng Wang, Yanjun Zhang, Xiqiang Chang and Xin Yin
State Grid Xinjiang Electric Power Corporation, China

- The geographic factors are incorporated into the calculation model of the solar irradiance.
- The model of PV power station is constructed.
- The model of the collector line, substation transformer, and the plant-level control system are described.
- The accuracy of the proposed model is verified in comparison with the measured data.



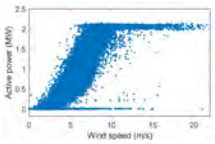
Comparison of daily irradiance in two regions

ThB3(4) 15:45-16:00

Voltage Control Strategy for Wind Farm Based on Probability Model of Voltage Droop Gain

Changchang Xie[1] and Yurong Wang[5]
School of Electrical Engineering, Southeast University, China
Rong Ye[2], Yuchen Tang[3] and Jingwei Xue[4]
State Grid Fujian Economic Research Institute, China

- Reactive power output of WTs can regulate the voltage fluctuations of the power system
- The time-varying nature of wind speed and the uncertainty characteristics of wind power
- Different distribution ranges of reactive power capacity from WTs in a WPP
- The probability model of voltage droop gain can make WTs output reactive power reasonably



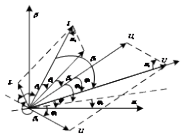
Active power output of the WT

ThB3(5) 16:00-16:15

VSG Based on Spatial Phase Analysis of PV for Unbalanced Voltage Grid Fault

Lingxiao Yan, Jun Mei, Pengfei Zhu and Sen Zhang
School of Electrical Engineering, Southeast University, China
Fangwei Duan, Wei Fan
Electric Power Institute, State Grid Liaoning Electric Power Supply Co. Ltd, China

- This paper proposes an optimized VSG control strategy based on spatial phase analysis.
- The strategy can solve the fault problem of PV system facing unbalanced voltage fault in grid.
- The strategy control the fault current and reduce second harmonic component of power of PV system connected to grid by analyzing different vectors affecting different electrical parameters.



Vector relationship diagram of voltage and current

ThPo4: Poster Session 4

Room : Grand Ballroom Foyer, 16:30-16:50, Thursday, July 29, 2021

ThPo4(1) 16:30-16:50

Research on modelling and simulation of cement raw meal predecomposition process

Zhaohui Ma, Hongliang Yu, Xiaohong Wang and Thabiso Tapera
School of Electrical Engineering, University of Jinan, Jinan, China

- The predecomposition process of cement is an important part of cement production. It has a great impact on cement production energy consumption, and the quality of cement. The preheating sub-process is relatively simple and thus the forgetting factor recursive least square method (FFRLS) is used to model the temperature of each stage in the preheater. The decomposition sub-process is relatively complex, so the working conditions of the precalciner are first identified, and the temperature simulation model based on fruit fly optimized least squares support vector machine (FOA-LSSVM) is established for each precalciner working conditions. The successful development and application of the simulation system based on the above model verify the effectiveness and practicability of the above research results. The model proposed in this paper is validated through case study.

ThPo4(2) 16:30-16:50

Improved Active Disturbance Rejection Method for Electric Cylinder Servo Control

Hongjun Chen, Jianlin Wei, and Fumen Cai
Department of Electrical Engineering,
Harbin Institute of Technology, China

- Active disturbance rejection control (ADRC) for the electrical cylinder applications
- Identification of inertia and load torque
- New state observer improves ADRC performance

ThPo4(3) 16:30-16:50

Analysis of the Application of 5G Communication Technology in Power CPS

Pan Zhang, Yue Zheng, Xianxu Huo
State Grid Tianjin Electronic Power Company, China
Yichen Li, Xia Zhou, Tengfei Zhang
Nanjing University of Posts and Telecommunications, China

- Demand analysis of power CPS business
- scenarios of 5G communication technology in power CPS business
- 5G network slicing scheme in power CPS environment

5G-based power business network slicing overall plan

ThPo4(4) 16:30-16:50

3D Lidar SLAM Based on Ground Segmentation and Scan Context Loop Detection

Mingce Guo[1,2], Lei Zhang[2], Xiao Liu[1,2], Zhenjun Du[2], Jilai Song[2], Mingmin Liu[2], Xiangrui Wu[1,2] and Xiaochuang Huo[1,2]
1. Faculty of Robot Science and Engineering, Northeastern University, China;
2. Shenyang SIASUN Robot & Automation Co., China;

- We completed the local pose constraints by segmenting and fitting the ground plane.
- We used the Scan Context loop detection method to detect and correct the global poses.
- Our method increased the speed of point cloud registration and obtained more accurate 6-DOF poses.
- Our method can effectively reduce the cumulative error and realize robust localization and accurate map construction.

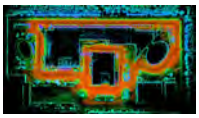


Figure 1. The large outdoor scene of the C1 office building in SIASUN.

ThPo4(5) 16:30-16:50

A Novel Bottom-Up Semi-Supervised Learning Framework for Salient Object Detection

Yu Pang, Chengdong Wu and Xiaosheng Yu
Faculty of Robot Science and Engineering, Northeastern University, China
Hao Wu
Australian Centre for Field Robotics, the University of Sydney, Australia
Yunhe Wu
College of Information Science and Engineering, Northeastern University, China
Wei Zhou
College of Computer Science, Shenyang Aerospace University, China

- We propose a novel bottom-up semi-supervised learning(SSL) framework for salient object detection
- A novel segmentation-based method(SBM) to select training samples from an image
- We contribute a novel label propagation to label some complex image regions.

From left to right : Input image, coarse map, SSL and Ground Truth

ThPo4(6) 16:30-16:50

Application of YOLO Object Detection Network In Weld Surface Defect Detection

Yinlong Zuo
Faculty of Robot Science and Engineering, NortheasternUniversity, China
Jintao Wang and Jilai Song
Shenyang Institute of Automation, Chinese Academy of Sciences, China

- By working with welding experts, a large-scale weld defect datasets of 5000 pictures is built.
- The weld defects detection model reaches 75.5% mean average precision in constructed weld defect dataset.
- The construction cost of the detection model and the deployment time of the detection system are greatly reduced.

ThPo4: Poster Session 4 (cont.)

Room : Grand Ballroom Foyer, 16:30-16:50, Thursday, July 29, 2021

ThPo4_2(7) 16:30-16:50

Effect of high speed grinding on surface integrity of cycloid gear

Lanying Xu, Qiang Wu* Yongbin Huang and Guoshan Ye
College of Electromechanical Engineering, Guangdong Polytechnic Normal University, China

- The surface roughness of cycloid wheel is improved with the increase of grinding wheel speed and the decrease of grinding depth and table speed
- Through analyzing the effect of high speed grinding on surface integrity, the optimal grinding parameters in this study are obtained as follows: Vs=120 m/s, Vw=5m/min, ap=0.03 mm.

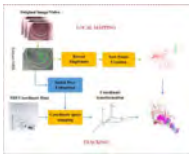
High speed grinding test site

ThPo4_2(8) 16:30-16:50

ORBSLAM combined with electromagnetic tracking in duodenum 3D reconstruction

Yan Zou[1,2],Yongming Yang[2],Chongyang Wang[2],Yongping Huang[2],Li Chang[1]and Hao Liu[2]
1.School of Information Science and Engineering,Shenyang University of Technoiogy,Shenyang,China
2.State Key Laboratory of Robotics,Shenyang Institute of Automation, Chinese Academy of Sciences,Shenyang,China

- Accurate 3D reconstruction of duodenum is very important in the navigation of ERCP surger
- Use the accurate tracking performance of electromagnetic sensors to improve the effectiveness of SLAM mapping
- Replace the pose estimation of the camera in SLAM with electromagnetic sensing real-time pose



Electromagnetic sensing combined with ORB-SLAM framework diagram

ThPo4_2(9) 16:30-16:50

Multi-object Grasping Detection in Cluttered Scenes Based on Deep Learning

Xiangrui Wu[1,2], Fang Xu[2], Zhenjun Du[2], Jilai Song[2], Mingmin Liu[2], Hongyan Liu[2], Kun Du[1,2] and Mingce Guo[1,2]
1. Faculty of Robot Science and Engineering, Northeastern University, China;
2. Shenyang SIASUN Robot & Automation Co., China;

- Redesign the original neural network structure based on GPD algorithm so that it can learn fewer parameters while the accuracy is basically unchanged.
- Select the GraspNetAPI dataset to generate training and test dataset, use the force closed-loop principle to generate grab labels.
- Propose a method that combines Mask R-CNN semantic segmentation network to detect objects of interest,

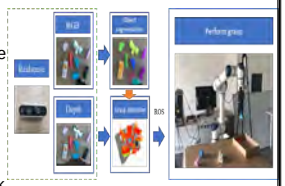


Figure 1. Grasp experiment process

ThPo4_2(10) 16:30-16:50

Auto-Tuning Deep Stereo on the Fly

Zhiyi Ni, Tong Jia and Xiaofang Li
College of Information Science and Engineering, Northeastern University, China

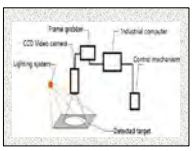
- Stereo matching
- Self-supervised learning
- Online adaptation
- Deep learning

ThPo4_2(11) 16:30-16:50

Research on product identification and positioning technology of machine vision based on Yolo detection framework

Fangzheng Wu
Computer science department, Rutgers-the State University of New Jersey, United States

- The vision model can accurately identify the target product Based on the design of the machine vision model through parameter optimization and adjustment of the model structure.
- Selecting YOLOv3 as the object positioning algorithm framework improves the recognition and positioning performance of the model, and verifies that the experimental model can meet the real-time requirements of object detection. However, adopting YOLOv5 can further improve the recognition ability, and can detect the target in the case of meeting the real-time needs.



Hardware layout of the detection system

ThPo4_2(12) 16:30-16:50

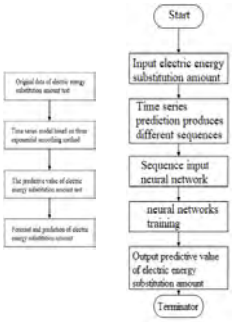
Analysis Method of Electric Energy Substitution Potential Based on Time Series and BP Neural Network

Huang Chongyang, Dai Chengcheng, Liao Minle, Li Hualin and Fan Gaosong
Chongzuo Power Supply Bureau of Guangxi Power Grid Co., Ltd.

Based on the quantification of the electric energy substitution potential with the electric energy substitution amount, this paper proposes a combined prediction method based on time series and BP neural networks.

The time series model of the smoothing method is used to predict the electric energy replacement amount, and the prediction result is corrected by using a BP neural network.

The National Bureau of Statistics' energy is used as data for forecasting and comparative analysis. The calculation results reveal that the combined prediction based on time series and BP neural network can significantly improve the prediction accuracy of electric energy substitution compared with single-method prediction, which has certain guiding significance for the analysis of electric energy substitution potential.



ThPo4: Poster Session 4 (cont.)

Room : Grand Ballroom Foyer, 16:30-16:50, Thursday, July 29, 2021

ThPo4_3(13) 16:30−16:50

A Review of Sensors and Machine Learning in Animal Farming

Ahmed Yaseer, Heping Chen
Ingram School of Engineering, Texas State University, USA

- Review of temperature and vision sensors, accelerometers, RFID tags, RTLS, respiration and heart rate sensors in animal farming
- Review machine Learning methods used for disease, behavior, production, and visual monitoring
- Present future research directions in sensors and machine learning for animal farming applications

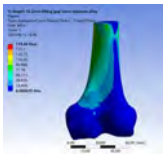
Architecture with sensors and machine learning for IoT applications

ThPo4_3(14) 16:30−16:50

The effect of the range of bone defect and filling material on the unicondylar knee arthroplasty with the finite element method

Xinglei Tu and Minglin Li
College of Mechanical Engineering and Automation,
Fuzhou University, China

- Metal filling can enhance the stability of UKA prosthesis.
- Expand the filling range of bone defect within an appropriate range without affecting its stability.
- The influence of the medullary cavity extension rod on the stability is very small.



ThPo4_3(15) 16:30−16:50

Research on variable scale target tracking method based on multi feature fusion

Hou Xuyang, Zhang Ying , and Du Facang
the School of Information and Control Engineering,
Shenyang Jianzhu University， China.

- In order to solve the problem of real-time accurate tracking when the size of the target fluctuates greatly, many problems exist at the same time. Based on KCF algorithm, LBP features are fused adaptively by using feature weighting method, and variable scale updating strategy is added
- A variable scale tracking method under multi feature fusion is proposed. In this paper, video sequences from obt-50 and obt-100 datasets are selected for simulation experiments, and the proposed algorithm is compared with KCF algorithm
- The position error is improved by 1% - 2%, and the overlap accuracy is improved by 2% - 3%, which verifies the robustness of the algorithm. When complex background, illumination, rotation, deformation and scale change appear in the process of target motion, the algorithm can solve the above problems

ThPo4_3(16) 16:30−16:50

A Review on Multi-objective Optimization of Coordinated Control in Cement Clinker Calcination Process

Zongliang Ma, Ping Jiang*, Shi Li, Xiaohong Wang
School of Electronic Engineering, University of Jinan, Shandong, China.

- The purpose and significance of Multi-objective Optimization of Coordinated Control in Cement Clinker Calcination Process
- Introduction of cement clinker calcination
- Common modeling methods
- Multi-objective optimization of coordinated control

Friday Sessions

FrR1: Power and Energy Systems

Session Chairs: Haoming Liu and Lixia Sun

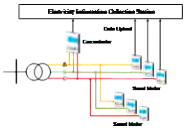
Room : Ramada Grand Ballroom A, 11:00-12:30, Friday,July 30,2021

FrR1(1) 11:00-11:15

Phase Identification with Single-Phase Meter and Concentrator Based on NMF Dimension Reduction and Label Propagation

Kepeng Chen, Jian Shi, Xunhu Wei and Shilong Cai
State Grid Electricity Power Research Institute, China

- NMF is used for dimension reduction to get better features instead of PCA
- Semi-supervised clustering method combined with concentrator data is used to replace unsupervised clustering
- The label propagation algorithm is used for phase identification to achieve 100% accuracy and millisecond operation time



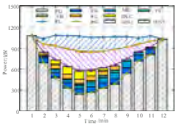
Phase identification in distribution network

FrR1(2) 11:15-11:30

An Emergency Control Strategy for Blackout based on IESs in Distribution Network

Chunlin Zhong, Chao Fang, Yuxuan Jiang, and Sumeng Tao
Jiangsu Fangtian Electric Power Technology, China
Sumeng Tao
State Grid Jiangsu Electric Power Co. LTD,. China

- To apply the potential of the integrated energy systems to emergency scenarios of power system control, a strategy based on IESs is proposed in this paper which is utilizing the architecture of multi-agent. The strategy is composed of dynamic potential assessment of IESs and control demand decision of the distribution operator, which is verified on the IEEE-33 node test case.
- Demand response; integrated energy system; emergency control.



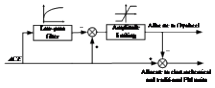
IES controllable equipment adjustment sequence and capacity allocation diagram and sale price

FrR1(3) 11:30-11:45

Control Strategy of AGC Considering Hybrid Energy Storage Resources

Lin Zhao, Meng Yang, Ren Zhang and Haoming Liu
College of Energy and Electrical Engineering, Hohai University, Nanjing

- Discrete Fourier Transform is used to analyse features of area control error(ACE) in frequency domain.
- High-frequency component of ACE is allocated to flywheel energy storage system(ESS).
- Low-frequency component is preferentially allocated to electrochemical ESS.
- The maximum charging/discharging power of the electrochemical ESS is modified by state of charging.



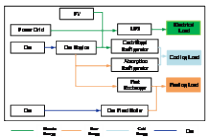
Strategy of high-frequency and low-frequency signals' division

FrR1(4) 11:45-12:00

Optimal Configuration Strategy of Integrated Energy System in Green Data Center

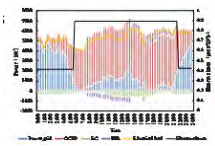
Chen Fu, Mingxing Guo, Chanjuan Tang, Panpan Liu, Weibo Xuan and Haoming Liu
College of Energy and Electrical Engineering, Hohai University, China

- The data center (DC) is equipped with integrated energy system (IES).
- A multi-objective optimization mathematical model is established, aiming at the least annual total cost and carbon emission.
- The electrical, heating and cooling power load balance constraints are considered.
- The results show that the total annual cost and carbon emission of DC are reduced together with PUE.



Energy flow diagram of IES in green DC

FrR1(5) 12:00-12:15



Optimization results of electrical supply

FrA1: Optimization and Control

Session Chair: Yong Jiang

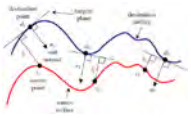
Room : Juxian A, 11:00-12:30, Friday,July 30,2021

FrA1(1) 11:00-11:15

Weight algorithm based depth camera point-to-plane ICP algorithm

Zeng YJ and Jiang Y
the College of Information Science and Engineering, Northeastern University, Shenyang, China. State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences Shenyang, China.

- we propose a new stable weight method for ICP algorithm of point-to-plane error metric.
- We propose a depth value quadratic attenuation algorithm based on the characteristics of depth cameras.
- Results show that our ICP algorithm achieves state-of-the-art results in terms of accuracy.



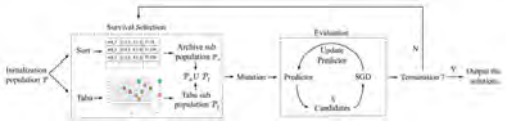
Point-to-plane error metric ICP algorithm.

FrA1(2) 11:15-11:30

Neural Architecture Search Based on Tabu Search andEvolutionary Algorithm

Zhun Fan*, Zhoubin Long, Wenji Li, Zhaojun Wang, Zhi Yang and Liu Wang
College of Engineering, Shantou University, China

- A new neural architecture search (NAS) method is proposed.
- We combine evolutionary algorithm and tabu mechanism in NAS work.
- The extensive experiment results prove that the tabu mechanism can improve the performance of NAS.



The overview of proposed framework.

FrA1(3) 11:30-11:45

Energy Consumption in a Collaborative Activity Monitoring System using a Companion Robot and a Wearable Device

Fei Liang, Ricardo Hernandezand and Weihua Sheng
Electrical and Computer Engineering, Oklahoma State University, USA
Ye Gu
Shenzhen Technology University, Shenzhen Guangdong, China

- Energy consumption problem for communication between a companion robot and a wearable device
- The effect of bandwidth on time cost and energy consumption
- An optimization problem on image sizes
- Evaluate the energy consumption and its optimization through both simulation and experiments.

Overall System

FrA1(4) 11:45-12:00

A Cloud Platform for Remote Data Interaction and Visualization in Lower Limb Exoskeleton Robot

Yue-Peng Zhang, Guang-Zhong Cao, Xuan-Ye Meng, *Zi-Qin Ling*, Sheng-Bin Cao, and Wen-Zhou Li
Guangdong Key Laboratory of Electromagnetic Control and Intelligent Robots, Shenzhen University, China

- A cloud platform for remote data interaction and visualization in lower limb exoskeleton robot is developed (Fig. 1).
- The test experiment of remote data interaction and visualization function of cloud platform is carried out.
- Experiments show that the proposed cloud platform can realize the functions of data storage, remote human-computer data interaction and visualization

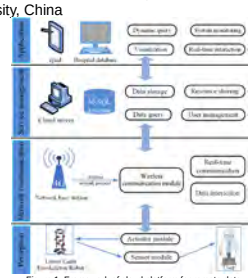


Figure 1. Framework of cloud platform for remote data interaction and visualization

FrB1: Measurement and Prediction

Session Chair: Yuliang Zhao

Room : Jude B, 11:00-12:30, Friday,July 30,2021

FrB1(1) 11:00-11:15

An Improved Convolutional Neural Network for Rolling Bearing Fault Diagnosis

Zi-qin Ling Guang-Zhong Cao and Yue-Peng Zhang
Guangdong Key Laboratory of Electromagnetic Control and Intelligent Robots, Shenzhen University, China

- An improved convolution neural network model for rolling bearing fault diagnosis is proposed (Fig. 1).
- The proposed neural network model solves the problem that the existing end-to-end neural network model is not accurate and improves the accuracy of fault diagnosis.
- the classification accuracy of the improved convolution neural network is 99.95%, and the F1 value is 0.9966.

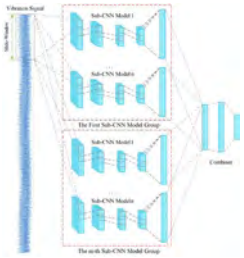


Figure 1. Proposed neural network model

FrB1(2) 11:15-11:30

The Gender,Height,Weight Prediction Based on Gait Using MEMS Sensor

Hualin Xing and Lirong Ren
School of Control Engineering, Northeastern University at Qinhuangdao, China
Yuliang Zhao
Department of Mechanical and Biomedical Eng., City University of Hong Kong,China

- Human gait is one of the behavioral biological feature for personal identification and authentication.
- Gender, height, and weight information are also used as soft biological features in medical care, intelligent biological systems and other systems.
- We propose a method to predict three human biological characteristics (gender, height and weight) based on gait data collected by a single wearable sensor.

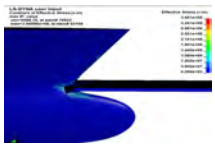
Data obtained by people wearing sensors

FrB1(3) 11:30-11:45

Structural response of ship-ice collision based on finite element method

Dong Yi
college of Control Engineering, Northeastern University at Qinhuangdao, Qinhuangdao

- The ship will collide with sea ice when sailing in the polar regions.
- This paper uses the finite element method to study the ship-ice collision.
- The effect of ship speed, collision angle and ice thickness on collision.



Stress diagram of ship-ice collision

FrB1(4) 11:45-12:00

Behavioral Recognition of Mice Based on a Deep Network

Xingqi Wang and Sheng Hu and Yuliang Zhao
Control engineering, Northeastern University, China
Chen Du and Ying Wang
Biomedical engineering, Beihang University, China

- In this paper, the field experiment scheme is adopted in animal behavior experiment.
- A multi-time fusion image preprocessing method is proposed.
- The trained convolutional neural network VGG16 model was used to predict the behavior of mice.
- This method has the characteristics of accurate classification, high accuracy and low cost.

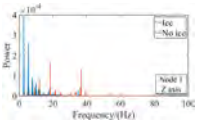
The mice image

FrB1(5) 12:00-12:15

IMU Sensor-based Vibration Measuring of Ship Sailing

Zhiwei Sun
Northeastern University at Qinhuangdao,China

- This paper proposes an IMU-based on-site measurement method of ice-induced vibration.
- The method can achieve long-term effective collection of ice-induced vibration data without supervision
- Time-frequency analysis of the ship's hull vibration laws in ice-free and ice-free areas
- The method provides a reference for on-site measurement of ship ice-induced vibration



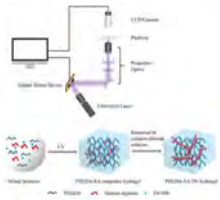
Comparison of the power spectrum of the axis of node 1 in the ice-free and the ice-free areas

FrB1(6) 12:15-12:30

A novel encapsulating method of pasteurized *Akkermansia muciniphila* with double-network hydrogel microstructures by a digital mask printing system

Zhilong Lu, Xiaoli Luan and Gongxin Li
Key Laboratory of Advanced Process Control for Light Industry (Ministry of Education), Institute of Automation, Jiangnan University

- The new method for encapsulating the pasteurized *Akkermansia muciniphila* with poly(ethylene glycol) diacrylate and sodium alginate .
- Using a digital mask printing system to fabricate double-network hydrogel microstructures.
- The fluorescence images show the successful encapsulating of pasteurized *Akkermansia muciniphila.*



FrR2: Machine Learning and Applications

Session Chair: Daoxiong Gong

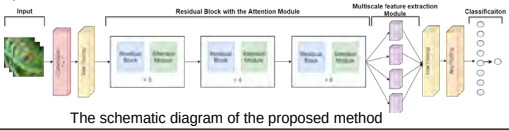
Room : Ramada Grand Ballroom A, 13:30-15:00, Friday,July 30,2021

FrR2(1) 13:30-13:45

Diagnosis Method of Tomato Leaf Disease Based on an Improved Deep Convolution Neural Network for Real-life Agriculture Environment

Xiaoyu Hou, Jin Yan, Wei Pan, and Yong Liu*
School of Computer Science and Engineering,
Nanjing University of Science and Technology, China

- we propose a diagnosis method to identify disease for real-life agriculture environment.
- The model is based on residual block with multiscale feature extraction module.
- The effective and lightweight attention module is added to the model.
- The method has good performance on our constructed dataset with complex conditions.



The schematic diagram of the proposed method

FrR2(2) 13:45-14:00

The Fieldscapes Dataset for Semantic Field Scene Understanding

Wei Pan, Jin Yan, Xiaoyu Hou, and Yong Liu*
School of Computer Science and Engineering,
Nanjing University of Science and Technology, China

- Fieldscapes uses almost full-pixel semantic annotation and partial category instance annotation in field scenes.
- The images were collected from different agricultural environments for various changes in field scenes.
- Fieldscapes pays more attention to the slow-developing agricultural scene understanding tasks.
- Fieldscapes meets the needs of semantic segmentation and instance segmentation at the same time.

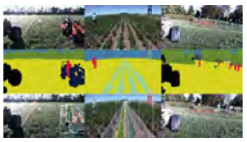


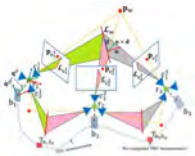
Illustration of Fieldscapes

FrR2(3) 14:00-14:15

PLMCVIO: Point-Line based Multi-Camera Visual Inertial Odometry

Fan Wang[12], Chaofan Zhang[1], Yong Liu[1] and Yingwei Xia[1]
[1]Anhui Institute of Optics and Fine Mechanics, Hefei Institutes of Physical Science, Chinese Academy of Sciences, China
[2]University of Science and Technology of China, China
Gang Zhang and Xuezhi Yang
Hefei University of Technology, China

- An accurate and robust tightly-coupled point-line based multi-camera visual-inertial odometry is presented
- To gain precise initial parameters, an improved multi-camera visual initialization method using point and line features is proposed
- We develop a general hyper-graph optimization method, which is suitable for MCVIO and improves accuracy of state estimation
- Public dataset and real-world experiments are performed to validate the performance of PLMCVIO



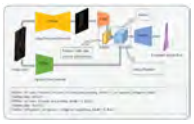
An illustration of point-line based multi-camera visual inertial odometry

FrR2(4) 14:15-14:30

Edge Detection-Based Optical Flow Estimation Method

Guoyu Zuo, Chengwei Zhang, Jiayuan Tong, Daoxiong Gong and Mengqian You
Faculty of Information Technology, Beijing University of Technology, Beijing 100124, China

- An edge detection-based optical flow model (EDOF) is proposed to improve the accuracy of optical flow estimation.
- EDNet module is used to obtain the features with the edge information of the objects.
- OFNet extracts the features with other common features of the object and others.
- Experiments on the public MPI Sintel and Flying Chairs datasets show the effectiveness of our method.



The architecture of the EDOF model.

FrA2: Agriculture Robotics

Session Chair: Jizhan Liu

Room : Juxian A, 13:30-15:00, Friday,July 30,2021

FrA2(1) 13:30-13:45

Research Progress of Urban Dual-arm Humanoid Grape Harvesting Robot

Yun Peng, Jizhan Liu*, Binbin Xie, Haiyong Shan, Meng He, Guangyu Hou, and Yucheng Jin
School of Agricultural Engineering, Jiangsu University, China

- Grape Harvesting Robot

Harvesting
production–leisure

- Main research contents

Recognition & Position
End-effector, dual-arm, hand-eye servo
Voice module
Navigation based on lidar and camera
Commercial Dual-arm humanoid grape picking robot system integration

Research contents

FrA2(2) 13:45-14:00

Visual Tracking Method of Tomato Plant Main-Stems for Robotic Harvesting

Qingchun Feng, Wei Cheng, Wanhao Zhang and Bowen Wang
Beijing Research Center of Intelligent Equipment for Agriculture, China

- The visual tracking method of tomato main-stem was proposed to improve for fruits' robotic detection.
- The plant's main-stem was identified based on Mask RCNN.
- Main-stem centerline was located according to its image moment feature.
- The control method of camera's posture was proposed to scan and search along the main-stem.

Principle of visually tracking main-stem

FrA2(3) 14:00-14:15

Research progress on Autonomous Navigation Technology of Agricultural Robot

Xie Binbin, Liu Jizhan, He Meng, Wang Jianand Xu Zhujie
School of Agricultural Engineering, Jiangsu University, China

- Agricultural Robot

Complex environment(Field/Orchard/Greenhouse)
Diversification(Tillage-Planting-Management-Harvesting)

- Autonomous Navigation

Technical requirement(Navigation and Cooperative control)
Technical Framework(Global navigation/Local navigation)
Technical principles(Detection-Control-Execution)

- Research project

Field driverless/Crop adaptive harvesting/Orchard navigation/Greenhouse navigation

Existing research

FrA2(4) 14:15-14:30

Identification and Localization of Optimal Picking Point for Truss Tomato

Jiawen Yan and Pengbo Wang*,Tianjian Wang, Guofeng Zhu,Xiaoliang Zhou ,Zhan Yang
Jiangsu Provincial Key Laboratory of Advanced Robotics, Soochow University, China

- Segmentation of the overall picking area based on Mask R-CNN
- Move the camera forward and set the depth threshold
- Segmentation of the optimal picking point area based on Mask R-CNN
- The second location of optimal picking point

Truss tomato picking area definition

FrA2(5) 14:30-14:45

Tomato Fruit Maturity Detection Method Based on YOLOV4 and Statistical Color Model

Xiaoliang Zhou, Pengbo Wang, Guanglin Dai, Jiawen Yan,and Zhan Yang
School of Mechanical and Electrical Engineering, Soochow University,China

- Using YOLOV4 to detect and identify tomato fruits, the recognition accuracy is over 95%.
- An algorithm of tomato fruit maturity detection based on RGB color space was proposed.
- The main color feature extraction method based on K-means was used to remove the background and noise of tomato fruits.

Greenhouse Scouting robot

FrB2: Mechanism and Control

Session Chair: Lina Hao

Room : Jude B, 13:30-15:00, Friday,July 30,2021

FrB2(1) 13:30-13:45

Design, Analysis and Experimental Research of Humanoid Head Robot

Hongshuai Liu and Wenlin Chen
Hongsheng Gu, Ying Zhang and Lina Hao
Northeastern University, China

- Two human-like eyeballs that can be controlled separately
- The whole head is mainly designed with SMA and IPMC smart materials
- The neck, eyes, jaw, and eyebrows are theoretically analyzed
- The experimental results show that the designed humanoid head robot is effective

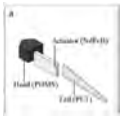
Humanoid Head Robot

FrB2(2) 13:45-14:00

A Miniature Underwater Robot Inspired by the Movement of Tadpoles

Shihan Fu and Chao Yin
School of Mechanical Engineering and Automation, Fuzhou University, China
Fana Wei
School of Mechanical Engineering and Automation, Fuzhou University, China

- This is a miniature soft robot driven by magnetic field
- The robot's propulsion model is inspired by the Movement of Tadpoles
- The tail has a traveling wave deformation, which is used to generate vortexes



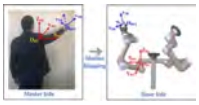
The basic structure of the robot

FrB2(3) 14:00-14:15

A Geometric Motion Mapping Algorithm from Master Human Arm to Heterogeneous Slave Robot Arm with Offset Joints

Daoxiong Gong, Ruihua Wang and Jianjun Yu
Faculty of Information Technology, Beijing University of Technology, China

- Motion mapping from master human arm to heterogeneous slave robot arm with offset joints
- Exactly achieve the same poses (position/ orientation) of the master/slave end-effector
- Similar master/slave elbow motion pattern in term of elbow elevation angle
- The algorithm is fast, intuitive, and efficient for tele-operation

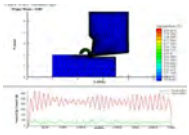


FrB2(4) 14:15-14:30

Analysis on the cutting performance of three-dimensional surface of superhard tool

Qiang Wu, Huijie Li and Lanying Xu
College of Electromechanical Engineering, Guangdong Polytechnic Normal University, China
Fangzheng Wu*
Computer science department, Rutgers-the State University of New Jersey, United States

- The related research is mainly carried out by setting up the chip breaker method on the basis of optimizing the tool. Optimize metal cutting process software was used to simulate and analyze a surface after 3D modeling.
- The experimental simulation comparison and analysis of the tool with chipbreaker and the unmodified tool reveal that the combined force of the X and Y axis after adding the chipbreaker saves an average of 2.45% of effort, which improves the cutting ability of the tool.



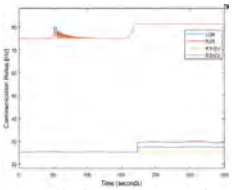
Simulation result while feed is 0.15mm/r

FrB2(5) 14:30-14:45

A Unified Framework for Bandwidth Management and Motion Control of Collaborative Robotic Swarms

Malak Slim, Naseem Daher, Member, Noel Maalouf, and Imad H. Elhajj
Vision and Robotics Lab, American University of Beirut, Lebanon

- Unifies motion control and bandwidth management for robotic swarms.
- Distributes bandwidth among communication channels based on factors that represent changes in the swarm and its environment.
- Factors include Interesting Events, Quality of Collaboration between agents, Quality of Control, and the Quality of Trajectory Generation of each agent of the swarm.



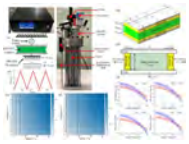
Communication rates between robots

FrB2(6) 14:45-15:00

Modeling of Planar Hydraulically Amplified Self-healing Electrostatic Actuators

Jiali Bao, Jing Xu
Department of Mechanical Engineering, Tsinghua University, China

- The electrostatic force is approximated to be an infinite parallel capacitor including three dielectric layers.
- The elastic force is predicted by Neo-Hookean model under biaxial condition.
- The volume is calibrated to reduce the error by nearly 50% since the aggregation of dielectric liquid used in pHASEL causes significant error in the electrostatic force prediction.
- The output forcess and the applied voltage under different sizes of pHASEL actuators are measured under different stretching lengths.



Modeling of electrostatic force and elastic force and experimental validation.

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