IEEE-CYBER

Changbai Mountain, China July 27-31, 2022

The 12th IEEE International Conference on

CYBER Technology in Automation Control and Intelligent Systems

PROGRAM

The 12th IEEE International Conference

on CYBER Technology

in Automation, Control, and Intelligent Systems

IEEE-CYBER 2022

Conference Digest

Changbai Mountain, China

July 27-31, 2022

IEEE-CYBER 2022 PROCEEDINGS

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Welcome Message

Welcome to the 12th IEEE International Conference on CYBER Technology in Automation, Control, and Intelligent Systems. The IEEE-CYBER is a key international conference focusing on advanced research areas related to cyber physical systems, control/automation, robotics, Internet of things, and sensor network. This year, the IEEE-CYBER conference will be held from July 27 to July 31, at the Wanda Jin Resort Changbaishan, Changbai Mountain, China, with the spirit of bringing together researchers and engineers from all over the world to present their latest research findings, accomplishments, innovations, and visions in the related fields.

With 361 paper submissions from 9 countries or regions, 236 papers have been selected for presentation at the conference after going through a rigorous review process. The technical program of the IEEE-CYBER 2022 consists of 3 plenary talks, 3 keynote talks, 21 technical sessions organized into 3 parallel tracks, and 4 poster sessions. The goal of IEEE-CYBER 2022 is to create an opportunity for participants to present their latest research results to international audiences. Moreover, networking with other researchers has always been a cornerstone of the IEEE-CYBER conference series, and several networking activities have been scheduled during the IEEE-CYBER 2022, including the welcome reception, banquet, and farewell reception. We hope the IEEE-CYBER 2022 will be a valuable, memorable, and exciting platform for people to exchange ideas and information, identify new research interests, establish collaborations, make friends, and find new opportunities for their careers.

The IEEE-CYBER 2022 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 would like to express our deepest gratitude to the great contributions from the Program Committee members, the Organizing Committee members, Award Committee members, Technical Committee members, Publicity Committee members, Finance Committee members, local staff, and student volunteers. The IEEE-CYBER 2022 would not have been possible without your commitment and efforts. Last but not least, our heartfelt thanks go to the authors, the reviewers, the conference participants, and the sponsors. It is your participation and contribution that will make the IEEE-CYBER 2022 unique, enjoyable, and successful.

Besides enjoying the technical programs and networking activities during the conference, we highly suggest you spend some time enjoying Changbai Mountain.

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

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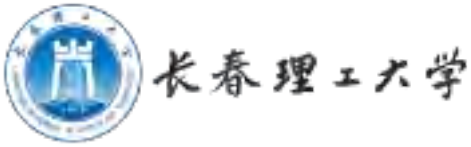
We acknowledge the support of the following Sponsors to the 12th IEEE International Conference on CYBER Technology in Automation, Control, and Intelligent Systems (IEEE-CYBER 2022).



GENERAL INFORMATION

Conference Date and Venue

Date: July 27-31, 2022
Venue: Wanda Jin Resort Changbaishan,
Changbai Mountain, China

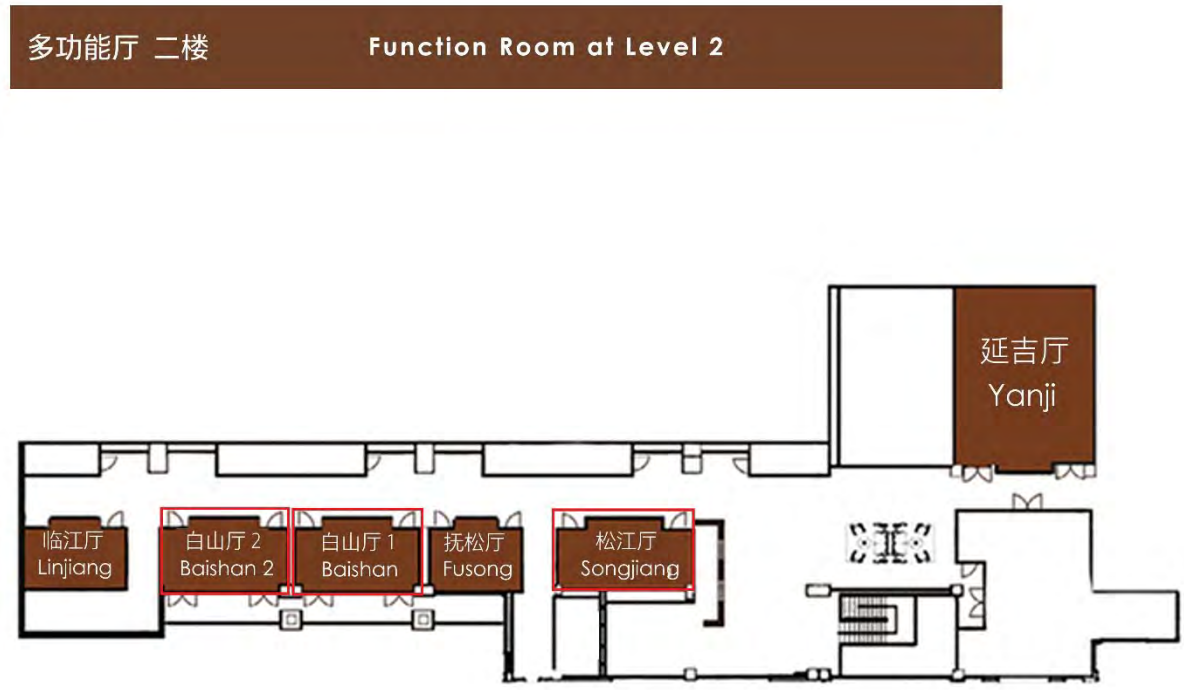
Registration Desk

July 27 (Wednesday)	14:00 - 18:00
July 28 (Thursday)	08:20 - 18:00
July 29 (Friday)	09:00 - 18:00
July 30 (Saturday)	09:00 - 16:00

Conference Events

Welcome Dinner	July 27	18:00
Lunch	July 28	11:50 - 13:05
Conference Dinner	July 28	18:00
Lunch	July 29	12:45 - 14:00
Conference Banquet and Award Presentation	July 29	18:00
Lunch	July 30	12:15 - 13:30
Farewell Dinner	July 30	18:00
Tour	July 31	08:30-17:30

Floor Map



Official Language

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

Conference Attire

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

Presentation Specifications

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

The duration for each category of oral presentation is listed below:

- Plenary Lectures are scheduled for 50 minutes (including Q&A) each.
- Keynote Lectures are scheduled for 40 minutes (including Q&A) each.
- Regular Sessions are scheduled for 12 minutes with 3 min Q&A each.

Poster Specifications

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

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

POSTER DIMENSIONS

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

POSTER CONTENT

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

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

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

About Changbai Mountain

Changbai Mountain is a volcano on the border between North Korea and China. This mountain is 54.5% in North Korean territory, and 45.5% in China. The China name is Changbai-shan. It means Snow piles up on the large mountain. The Korean name is Baekdu-san. It means White head mountain.

Changbai Mountain has a large crater lake, It is called Heaven Lake. Chinese called "tianchi" lake. It is 2,744 meters above sea level. The Beijing Olympic torch was lit on Baekdu/Changbai Mountain. Heaven Lake is the caldera made by a gigantic eruption in 969 AD (± 20 years).

Attractions

Tian Chi (Heaven Lake)

Changbai Waterfall

The Green Deep Pond

Julong Hot Springs

Plenary Talks

Plenary Talk 1: Thursday, July 28, 2022 08:30-09:20
Session Chair: Diansheng Chen, Beihang University

Reflections on Opportunities and Challenges Facing Scientific and Technological Achievements Transformation

Tianmiao Wang

Professor
Beihang University, China

Abstract:

With the historic opportunities emerging in past years, scientific and technological innovation and transformation have undergone new changes and characteristics. Ten disruptive technologies and five trillion potential markets may appear in the future. However, there have been a lot of problems in the transformation of scientific and technological achievements, such as long period, low success rate and low rate of return. Therefore, to promote transformation of scientific and technological achievements, China has issued a series of policies. Now, there are several ways of scientific and technological achievements transformation including IP business incubation companies, business incubation companies and entrusted professional agency CEO companies. Among these, Zhongguancun Zhiyou Scientist Fund builds a service platform for early scientific and technological investment in hard science and technology, lays out seed Angel hard science and technology incubation investment, explores innovative ways to transform scientific and technological achievements, and incubates a number of specialized and new small enterprises and invests in a number of high-quality projects, which has achieved a ideal result.

Biography:

Professor Tianmiao Wang has been a professor at Beihang University in the PRC since 1995. He was the expert panel leader of the national “863 Programme” on robotics technology and the honorary department head at the Graduate School of Robotics of Beihang University.

Prof. Wang is a “Cheung Kong” Scholar appointed by Ministry of Education and the National Science Fund for Distinguished Young Scholar. Prof. Wang is also associate editors of several journals.

He has achieved outstanding results in the research development of medical robots, bionic mechanical fish and embedded intelligent control.

Plenary Talk 2: Friday, July 29, 2022 09:00-09:50
Session Chair: Haibin Yu, Shenyang Institute of Automation, CAS

Cybertwin: An Origin of Cloud Native Network Architecture

Quan Yu

Professor
State Key Laboratory of Information Security, China

Abstract:

Internet of Everything (IoE) has been considered as the future of the Internet and could achieve intelligent connections of humans, processes, data and things. A revolutionary feature of the future network architecture for IoE is to support ubiquitous data collection, aggregation, fusion, processing, distribution and service. The disruptive change raises the issues and challenges of scalability, mobility, security and availability for the future network architecture design. In this talk, we draw on the interdisciplinary thinking involved with biology and economics, and present our systematic and original designs of cloud native network, fully-decoupled radio access network (FD-RAN), and endogenous secure elastic network, respectively. In terms of cloud native network, a cybertwin based original architecture is designed to accommodate the evolution from end-to-end connection to cloud-to-end connection in the future network. In the aspect of wireless access network, through the deep investigations of signal transmission mechanism of brain neurons, FD-RAN is introduced by referring to biological thinking and enlightenment of "full decoupling" and "flexible collaboration". In the aspect of endogenous secure elastic network, the inspiration of antibody generation mechanism of biological immune system to network is analyzed, and a network security defense architecture based on biologic-like immunity is proposed. Finally, the basic characteristics of cloud native network architecture are summarized, shedding light on the direction for future network architecture design.

Biography:

Quan Yu received the B.S. degree in radio physics from Nanjing University in 1986, the M.S. degree in radio wave propagation from Xidian University in 1988, and the Ph.D. degree in fiber optics from the University of Limoges(France) in 1992. He joined the faculty of the Institute of China Electronic System Engineering Corporation as a senior engineer in 1992, and is currently a Research Fellow of Peng Cheng Lab. His main areas of research interest are the architecture of wireless networks, optimization of protocols, and cognitive radios. Dr. Yu is an Academician of Chinese Academy of Engineering (CAE) and the funding Editor-in-Chief of Journal of Communications and Information Networks (JCIN).

Plenary Talk 3: Saturday, July 30, 2022 09:00-09:50
Session Chair: Lianqing Liu, Shenyang Institute of Automation, CAS

pHRI and its Industrial Applications

Kazuhiro Kosuge

Chair Professor
The University of Hong Kong, China

Abstract:

In this presentation, I would like to revisit the pHRI (Physical Human-Robot Interaction) from Cyber-physical Systems point of view. We have developed several pHRI systems including PBDR (Partner Ballroom Dance Robot) and its applications for industries. A Co-worker Robot "PaDY" (in-time Parts/tools Delivery to You robot) was developed as an application of pHRI for an automobile assembly process usually carried out only by a human worker. PaDY is a simple robot with two degrees of freedom, designed to be easily introduced into a real assembly process. When we try to apply this concept to different types of tasks, we encounter several issues. In this presentation, we will introduce an adaptive motion planning scheme that has been developed for easy implementation of the co-worker robot "PaDY." This provides an example of an architecture for applications of pHRI.

Biography:

Dr. Kazuhiro Kosuge (Life Fellow, IEEE) is Chair Professor of Robotic Systems in the Department of Electrical and Electronic Engineering, the University of Hong Kong. He received the B.S., M.S., and Ph.D. in control engineering from the Tokyo Institute of Technology, in 1978, 1980, and 1988 respectively. After having served as a R&D Staff of the Production Engineering Department, Nippon Denso Company, Ltd., a Research Associate at Tokyo Institute of Technology and an Associate Professor at Nagoya University, he joined Tohoku University as Professor in 1995 and served as Distinguished Professor from 2018 to March 2021. He received Medal of Honor, Medal with Purple Ribbon, from the Government of Japan in 2018, in the name of the Japanese Emperor, - a national honour in recognition of his prominent contributions to academic and industrial advancements. He also received IEEE RAS George Saridis Leadership Award in Robotics and Automation in 2021 for his exceptional vision of innovative research and outstanding leadership in the robotics and automation community through technical activity management. He is an IEEE Fellow, JSME Fellow, SICE Fellow, RSJ Fellow, JSAE Fellow and a member of the Engineering Academy of Japan. He was the President of the IEEE Robotics and Automation Society, from 2010 to 2011, the IEEE Division X Director, from 2015 to 2016 and the IEEE Vice President for Technical Activities for 2020.

Keynote Talks

Keynote Talk 1: Thursday, July 28, 2022 09:20-10:00
Session Chair: Lianqing Liu, Shenyang Institute of Automation, CAS

Aerial-aquatic robots capable of crossing the air-water boundary and hitchhiking on surfaces

Li Wen

Professor
Beihang University, China

Abstract:

Many real-world applications for robots such as long-term aerial and underwater observation, cross-medium operations, and marine life surveys require robots with the ability to move between the air-water boundary. Here, we describe an aerial-aquatic hitchhiking robot that is self-contained for flying, swimming, and attaching to surfaces in both air and water and that can seamlessly move between the two. We describe this robot's redundant, hydrostatically enhanced hitchhiking device, inspired by the morphology of a remora (Echeneis naucrates) disc, which works in both air and water. As with the biological remora disc, this device has separate lamellar compartments for redundant sealing, which enables the robot to achieve adhesion and hitchhike with only partial disc attachment. The self-contained, rotor-based aerial-aquatic robot, which has passively morphing propellers that unfold in the air and fold underwater, can cross the air-water boundary in 0.35 second. The robot can perform rapid attachment and detachment on challenging surfaces both in air and under water, including curved, rough, incomplete, and biofouling surfaces, and achieve long-duration adhesion with minimal oscillation. We also show that the robot can attach to and hitchhike on moving surfaces. In field tests, we show that the robot can record video in both media and move objects across the air/water boundary in a mountain stream and the ocean. We envision that this study can pave the way for future robots with autonomous biological detection, monitoring, and tracking capabilities in a wide variety of aerial-aquatic environments.

Biography:

Li Wen is a full Professor at Mechanical Engineering and Automation, Beihang University. His current research interests include bio-robotics, soft robotics, and comparative biomechanics. He published over 100 journal/conference papers including Science Robotics, Science Advances, IJRR, IEEE TRO etc. His representative work was featured by Nature, Science, MIT Technology review, BBC, and other scientific media presses. He was the recipient of the Chinese National Science Fund for Excellent Young Scholars in 2018, and Steven Vogel Young Investigator Award in 2020. He leads many projects including the Chinese National Science Foundation, Key project etc. Li Wen served as an associate editor of Soft Robotics, executive editorial board of Bioinspiration Biomimetics, and associate editor of IEEE Robotics and Automation Letters, etc.

Keynote Talk 2: Friday, July 29, 2022 09:50-10:00
Session Chair: Chengzhi Su, Changchun Univ. of Science and Technology

RFID for Mobile Robot: Navigation, Location and Control

Bo Tao

Professor
School of Mechanical Science and Engineering,
Huazhong University of Science and Technology, China

Abstract:

For the logistics and warehousing, the identity attributes and location attributes of items are two basic key information, which is of great significance for the transparent management of items. As an important component of the internet of Things, RFID realizes unique ID identification through non-contact electromagnetic communication. Compared with visual sensors, RFID has outstanding advantages, such as low cost and non-light interference, which provides a well solution for the problem of the identity attribute about “what the item is”. The RFID-based localization technology aims at solving the location attribute about “where the item is”, and would make RFID combine “ID sensor” and “location sensor”. This talk will introduce the principle and method of position sensing technology based on RFID, focusing on the target positioning method based on RFID phase information, robot autonomous positioning technology based on RFID information fusion, mobile robot navigation technology based on RFID phase difference and mobile robot servo control technology based on RFID phase gradient. Combined with specific examples, the application of location sensing technology based on RFID in intelligent manufacturing is also introduced.

Biography:

Bo Tao is a Changjiang Scholar Chair Professor at the School of Mechanical Science and Engineering, Huazhong University of Science and Technology (HUST). He received the B.S. and Ph.D. degrees in mechanical engineering from HUST in 1999 and 2007 respectively. After being a post-doctor from June 2007 to June 2009, he has been an Associate Professor in 2009 and a Professor in 2013 in HUST. From June 2013 to June 2014, he was a visiting scholar at the the Mechanical Engineering Department of UC Berkeley, USA. He is currently the Secretary General of the robot branch of Chinese Mechanical Engineering Society, and the Secretary General of the tri-co robot branch of Chinese Association of Automation. He has published 1 monograph, more than 80 papers in international journals and conference. He has won the second prize of national scientific and technological progress award, the second prize of National Technological Invention Award and the first prize of national teaching achievement award respectively, and has been authorized more than 30 national invention patents of China. His research interests mainly include intelligent manufacturing and robotics technologies RFID technology and application.

Keynote Talk 3: Saturday, July 30, 2022 09:50-10:30
Session Chair: Jian Li, Beijing University of Posts and Telecommunications

Challenges on Hand Exoskeletons for Rehabilitation and Assistance

Long Cheng

Professor
Institute of Automation, CAS, China

Abstract:

Hand is one most important organ of human beings, which plays a critical role in daily lives. Meanwhile, the hands have a strong connection with the human's nervous system. Therefore, the hand exoskeleton cannot only help the patients or the elderly to regain their hand functions in daily activities, but also serves as an important media of shaping the neural plasticity, which is valuable theoretically and practically. This talk discusses the technical challenges and progress on the mechanical design of the hand exoskeleton, the wearable sensors for measuring human's movement and interaction, and some advanced interaction control algorithms. Finally, this talk shares some promising results on building the closed-loop brain-computer interface by the hand exoskeleton in the literature.

Biography:

Long Cheng received the B.S. (Hons.) degree in control engineering from Nankai University, Tianjin, China, in 2004, and the Ph.D. (Hons.) degree in control theory and control engineering from the Institute of Automation, Chinese Academy of Sciences, Beijing, China, in 2009. He is currently a Full Professor with the Institute of Automation, Chinese Academy of Sciences. He is also an adjunct Professor with University of Chinese Academy of Sciences. He has published over 100 technical papers in peer-refereed journals and prestigious conference proceedings. He was a recipient of the IEEE Transactions on Neural Networks Outstanding Paper Award from IEEE Computational Intelligence Society, the Aharon Katzir Young Investigator Award from International Neural Networks Society and the Young Researcher Award from Asian Pacific Neural Networks Society. He is serving the Chair of IEEE Computational Intelligence Society Beijing Chapter (2022); the Associate Vice President of IEEE Systems, Man and Cybernetics Society (2022). He is an Associate Editor of IEEE Transactions on Cybernetics, IEEE Transactions on Automation Science and Engineering, Science China Technological Sciences, and Acta Automatica Sinica. His current research interests include the rehabilitation robot, intelligent control and neural networks.

IEEE-CYBER 2022 Conference Program

July 27 (Wednesday)	
14:00-18:00	**Registration**
18:00-20:00	**Welcome Dinner** *(for all registered attendees)*

<table>
<tr><th colspan="5">July 28 (Thursday)</th></tr>
<tr><td></td><td rowspan="11">Registration</td><td colspan="3">Tianchi 1, 1/F</td></tr>
<tr><td>08:20-08:30</td><td colspan="3">Opening Ceremony</td></tr>
<tr><td>08:30-09:20</td><td colspan="3">Plenary Talk 1: Tianmiao Wang, Beihang University, China
Reflections on Opportunities and Challenges Facing Scientific and Technological Achievements Transformation</td></tr>
<tr><td>09:20-10:00</td><td colspan="3">Keynote Talk 1: Li Wen, Beihang University, China
Aerial-aquatic Robots Capable of Crossing the Air-water Boundary and Hitchhiking on Surfaces</td></tr>
<tr><td>10:00-10:30</td><td colspan="1">Coffee Break</td><td colspan="2">ThPo1 - Poster Session 1
(ID: 5, 6, 9, 14, 17, 22, 23, 25, 26, 29, 30, 36, 37, 40
41, 42, 45, 46, 47, 48, 50, 54, 56, 57, 62, 64, 65, 66)</td></tr>
<tr><td>10:30-12:00</td><td colspan="3">ThA1 - Best Paper Session I
(ID: 49, 55, 125 ,142, 166, 179)</td></tr>
<tr><td>12:00-13:05</td><td colspan="3">Lunch (for all registered attendees)</td></tr>
<tr><td></td><td>Songjiang, 2F</td><td>Baishan 1, 2F</td><td>Baishan 2, 2F</td></tr>
<tr><td>13:05-14:35</td><td>ThB2 - Perception and Recognition I
(ID:16, 19, 31, 33, 38, 68)</td><td>ThB3 - Measurement and Prediction I
(ID:28, 39, 43, 77, 100, 112)</td><td>ThB4 - Robot Planning and Control I
(ID:80, 102, 104, 109, 134)</td></tr>
<tr><td>14:35-15:05</td><td colspan="1">Coffee Break</td><td colspan="2">ThPo2 - Poster Session 2
(ID:67, 69, 71, 72, 73, 75, 78, 79, 81, 85, 87, 90, 92, 93, 95，96
97, 98, 105, 106, 110, 113, 114, 115, 118, 129, 132,133，141)</td></tr>
<tr><td>15:05-16:35</td><td>ThC2 - Perception and Recognition II
(ID: 82, 99, 183, 253, 260, 284)</td><td>ThC3 - Measurement and Prediction II
(ID: 152, 160, 165, 248, 249, 268)</td><td>ThC4 - Robot Planning and Control II
(ID: 170, 176, 198, 208, 238, 296, 359)</td></tr>
<tr><td>18:00</td><td></td><td colspan="3">Conference Dinner
(for all registered attendees)</td></tr>
</table>

July 29 (Friday)				
	Registration	**Tianchi 1, 1/F**		
09:00-09:50		*Plenary Talk 2:* **Quan Yu**, *State Key Laboratory of Information Security* ***Cybertwin: An Origin of Cloud Native Network Architecture***		
09:50-10:30		*Keynote Talk 2:* **Bo Tao**, *Huazhong University of Science and Technology, China* ***RFID for Mobile Robot: Navigation, Location and Control***		
10:30-11:00		*Coffee Break*	FrPo3 - **Poster Session 3** (ID:103, 144, 146, 151, 158, 159, 161, 168, 169, 171, 187, 192, 201, 213, 219, 222, 223, 226, 228, 229, 230, 231, 232, 233, 234, 237, 240, 254)	
11:00-12:30		FrA1 - **Best Paper Session II** (ID: 236, 267, 274, 293,298, 300)		
12:20-13:30		***Lunch*** *(for all registered attendees)*		
		Songjiang, 2F	**Baishan 1, 2F**	**Baishan 2, 2F**
14:00-15:30		FrB2 - **Sensing and Recognition I** (ID: 20, 44, 86, 122, 136, 139)	FrB3 - **Medical Robot I** (ID: 13,18, 21, 61, 119, 138)	FrB4 - **Optimization and Control I** (ID:2, 7, 34, 53, 111, 189)
15:30-16:00		*Coffee Break*	FrPo4 - **Poster Session 4** (ID: 241, 242, 243, 245, 246, 247, 250, 255, 258, 259, 261, 262,263 266, 269, 271, 275, 276, 278, 279, 280, 287, 289, 301, 354, 357 358 ,)	
16:30-17:30		FrC2 - **Sensing and Recognition II** (ID 143, 185, 203, 220, 239, 361)	FrC3 - **Medical Robot II** (ID: 51, 127, 184, 186, 204, 217, 292, 319,)	FrC4 - **Optimization and Control II** (ID: 11, 196, 257 ,281, 290, 295)
18:00		**Conference Banquet and Award Presentation** (for all registered attendees)		

July 30 (Saturday)

	Registration	**Tianchi 1, 1/F**		
09:00-09:50		*Plenary Talk 3:* ***Kazuhiro Kosuge****, The University of Hong Kong* **pHRI and its Industrial Applications**		
09:50-10:30		*Keynote Talk 3:* ***Long Cheng****, Institute of Automation, Chinese Academy of Sciences, China* **Challenges on Hand Exoskeleton for Post-Stroke Patients**		
10:30-10:50		*Coffee Break*		
		Songjiang, 2F	**Baishan 1, 2F**	**Baishan 2, 2F**
10:50-12:05		SaA2 - **Mobile Robotics I** (ID:63, 76, 89, 101)	SaA3 - **Robots and Learning** (ID:12, 209, 252, 352)	SaA4 - **SLAM and Navigation** (ID:58, 88, 190, 199, 272)
12:05-13:30		***Lunch*** *(for all registered attendees)*		
13:30-14:45		SaB2 - **Mobile Robotics II** (ID: 137, 202, 251, 283, 299)	SaB3 - **Mechanism and Control** (ID: 175, 210, 273, 294, 351)	SaB4 - **Industrial Robotics and Applications** (ID:3, 108,120,154)
14:45-15:05		*Coffee Break*		
15:05-16:05		SaC2 - **Machine Learning and Applications** (ID: 27, 193, 270, 356)	SaC3 - **Intelligent Sensing and Control** (ID:116, 140, 218)	SaC4 - **Internet of Things** (ID:70, 214, 264, 355)
18:00		**Farewell Dinner** (for all registered attendees)		

July 31 (Sunday)	
08:30-17:30	**Technical Field Trip** Free of charge for all registered attendees (Please refer to conference website for booking in advanced)

Thursday Sessions

ThPo1: Poster Session 1

Session Chair: Li Wen

Room : Foyer, 1F, 10:00-10:30, Thursday, July 28

ThPo1(1) 09:50-10:20

Autonomous Cognition and Personalized Service Selection Based on Emotion-Space-Time Information for Home Service Robot

Fei Lu, Ying Yuan, Yuhong Liu, Guohui Tian and Hao Wu

School of Control Science and Engineering, Shandong University,P.R.China

- A user emotion based autonomous service cognition method and personalized service selection strategy for robot is presented
- Ontology technology is used to build the 3D ontology model of the home intelligent space
- Emotion-space-time rule base is encoded and BP neural network is adopted to construct the inference engine
- The change of user emotion is used as a reward feedback signal to realize dynamically adjust and personalized service selection

ThPo1(2) 09:50-10:20

Modeling and control of a soft-rigid hybrid robotic glove for hand rehabilitation and assistance

Yongkang Jiang

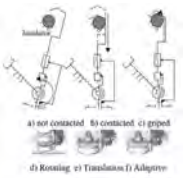
- Customizable design of soft-rigid hybrid joints based on a series-air-pouch and length-adjustable connector;
- Modeling and validation of the deformation and force response of the novel actuator;
- Development of a soft-rigid hybrid robotic glove and its performance evaluation.

ThPo1(3) 09:50-10:20

Mobility Analysis and Simulation of Metamorphic Detection Robot with Metamorphic Bevel Gear

Bingbing Yuan and Hongguang Wang
State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, China
Hui Yuan
Mechanical Engineering and Automation, Northeastern University, China

- The robot's gripper uses the adaptive variable mobility mechanism to ensure adaptability
- The modified formula of the Kutzbach-Grübler formula is derived for analyzing the mobility change of the closed-chain mechanism with the bevel gear train
- As shown in the figure, the final simulation verifies the rationality of the mechanism and the correctness of the proposed theoretical formula



a)->c)show the robot has variable mobility
d)->f) show the robot's adaptive gripping process

ThPo1(4) 09:50-10:20

An Intelligent Piano Playing Algorithm Applied to The Humanoid Robot

Guang Gao, Ling Zhong, et al
Zhejiang Lab, Hangzhou, China

- An intelligent piano playing algorithm for the piano humanoid robot was proposed;
- Visual location module realizes robust autonomous location of piano keys;
- Action scheduling module generates a series of optimum combined actions making the performance more fluent;
- The humanoid robot successfully played 30 pieces of piano songs in different styles and difficulties.

ThPo1(5) 09:50-10:20

Hybrid Controller and Switching Strategy of Ice-underwater Amphibious Robot based on Dynamic Model Observer

Liu XInyu, Lu Yang, Xin Chuanlong, Tan Dongxu and Li Shuo
Guangzhou Institute of Industrial Intelligence and Guangdong Institude of Intelligent Unmanned System and Shenyang Institute of Automation, China

- Ice-underwater **amphibious robot** with omni wheel and propeller
- Dynamic model of the robot driven by **omni wheel and propeller**
- Switch the motion state in time and track the desired **speed** by **observe** the wheel motion dynamics model and propeller motion dynamics model.

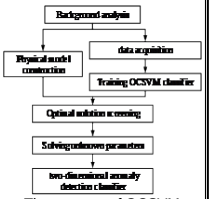
Robot move path

ThPo1(6) 09:50-10:20

Balance Control for Lower Limb Exoskeleton based on the Center of Mass

Ligang Liu, Wanxin Chen, Mengze Li, Jiawei Zhao, Bi Zhang and Xingang Zhao
State Key Lab of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, China. Institutes of Robotics and Intelligent Manufacturing, Chinese Academy of Sciences, China.

- Analyzing the characteristics human balance control and introducing an anomaly detection algorithm based on OCSVM.
- Designing a compliance controller by imitating human walking and balance recovery strategy characteristics.
- Firstly proposing the concept: CLoF and insteading of using the Base of Support (BoS).



The process of OCSVM anomaly detector

ThPo1: Poster Session 1 (cont.)

Session Chair: Li Wen

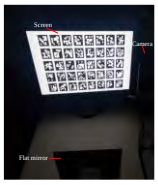
Room : Foyer, 1F, 10:00-10:30, Thursday, July 28

ThPo1_2(7) 09:50-10:20

A Robust and Flexible Geometry calibration Method for Phase Measuring Deflectometry

Xinggang Fan and Tianle Ma
College of Computer Science and Technology, Zhejiang University of Technology, China

- Combine square-based fiducial markers with a marker-less flat mirror
- Without prior manual image processing
- Only require to take a minimum of three images



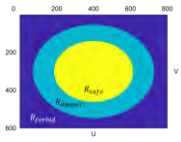
Calibration system

ThPo1_2(8) 09:50-10:20

Image-Based Visual Servoing under Field of View Constraints for Robot Manipulators

Guoyu Zuo, Yan Liu, Gao Huang and Daoxiong Gong
Faculty of Information Technology, Beijing University of Technology, China

- A novel constraint function is proposed to address the visibility constraints.
- The region boundaries defined in the image are added to the classical proportional controller, which leads the image features from the margin to the center of the image.
- Simulation results verify the efficiency of the modified controller by controlling a robot manipulator with eye-in-hand configuration.



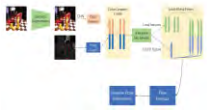
The Elliptic Field Constraints.

ThPo1_2(9) 09:50-10:20

An Efficient Color and Geometric Feature Fusion Module for 6D Object Pose Estiamtion

Jiangeng Li, Hong Liu, Gao Huang and Guoyu Zuo
Faculty of Information Technology, Beijing University of Technology, China

- An efficient fusion module that can fully leverage two complementary data sources.
- End-to-end 6D pose estimation method improves the prediction accuracy while obviously reducing the training time.
- Experimental results on LineMOD and YCB-Video dataset show that our method is high-efficiency and significantly boosts the performance.



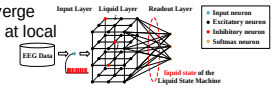
The overall framework of our method

ThPo1_2(10) 09:50-10:20

Particle Swarm Optimization of a Liquid State Machine for Epilepsy and Seizure EEG Signal Classification

Qingfeng Gong, Wenli Zhou, Zhuoyu Li, Kaiqiang Wen, and Zhoujun Sheng
School of Optical and Electronic Information,
Huazhong University of Science and Technology, China

- A liquid state machine is a bio-inspired computing model
- Particle swarm optimization could converge faster and effectively avoid being stuck at local optima
- The best accuracy of 95% for EEG classification was achieved by an optimized LSM with 160 neurons



The network structure of the LSM

ThPo1_2(11) 09:50-10:20

An Optimized Physical Reservoir Computing Through Genetic Algorithm

Kaiqiang Wen
China, Huazhong University of Science and Technology, Hubei wuhan
Wenli Zhou
China, Huazhong University of Science and Technology, Hubei wuhan

- Genetic algorithm is used to optimize the superparameter of physical RC
- The NRMSE of the NARMA10 task was reduced to 0.0877 by optimize computing
- The accuracy of epileptic EEG classification was improved to 98.33%

The systematic diagram of RC experimental platform

ThPo1_2(12) 09:50-10:20

AGV State Monitoring Based on Global and First-person View Fusion in Digital Workshops

Sichao Zhang, Wei Liang, Xudong Yuan and Yinlong Zhang
Shenyang Institute of Automation, Chinese Academy of Sciences, China
Gengyu Li
School of Information and Control Engineering,
Shenyang Jianzhu University, China
Haibo An
Science and Technology on Information Systems Engineering Laboratory,
The 28th Research Institute of CETC, China

- **A multi-view system** for AGV tracking in Digital Workshops
- In the global view, the AGV visual inspection method based on **Aruco code** is adopted
- In the AGV first-person view, pedestrian detection is performed and the corresponding distance is measured

Global and First-person View Vision Configurations for AGV

ThPo1: Poster Session 1 (cont.)

Session Chair: Li Wen

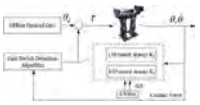
Room : Foyer, 1F, 10:00-10:30, Thursday, July 28

ThPo1_3(13) 09:50-10:20

Gait tracking control of biped robot based on adaptive gait switching algorithm

Jianjun YU, Ruiqi LI, Daoxiong GONG, Yixin LIU and Peng LIU
Beijing Key Laboratory of Computational Intelligence and Intelligent System, Beijing University of Technology, China

- This paper takes the **human walking data** as the desired gait of robot, and uses the periodic characteristics of gait, proposes a gait tracking control strategy of Biped Robot Based on **adaptive gait switching algorithm**.
- The experimental results show that **only two LQR controllers** to realize the accurate tracking of the desired gait of the biped robot, and the maximum gait speed reaches two



Block diagram of tracking control of biped robot

ThPo1_3(14) 09:50-10:20

Research on CT Image Super-resolution Reconstruction with Multi-branch Fusion Network

Zhipeng Ren, Jianping Zhao, Chunyi Chen, Peng Wang and Shutong Zhang
School of Computer Science and Technology, Changchun University of Science and Technology, China

- We proposed a multi-branch fusion network to reconstruct CT images.
- Local residual learning is introduced into each sub-network to improve the accuracy and convergence speed.
- Our method achieves better reconstruction effect, which will improve the accuracy of medical diagnosis.

ThPo1_3(15) 09:50-10:20

Design and Development of Foldable Domestic Rescue Capsule

Ziqiang Zhang and Shangkun Yang
Faculty of Materials and Manufacturing, Beijing University of Technology, China
Jun Li
Faculty of Materials and Manufacturing, Beijing University of Technology, China

- Domestic rescue capsule can provide emergency refuge space for people when urban disasters occur
- The rescue capsule has a folding structure, including an environmental monitoring system and a communication system
- Parametrically design the rescue capsule to make it resistant to impact and high temperature

Principle prototype of domestic rescue capsule

ThPo1_3(16) 09:50-10:20

Design and Optimization of Electric Vehicle Power Battery Box

Qiang Wu, Lanying Xu, Wenjun Jie and Renzhong Han
School of Automobile and Transportation Engineering, Guangdong Polytechnic Normal University, China
Fangzheng Wu
computer science department, Rutgers-the State University of New Jersey, United States

- As the country pays more and more attention to energy saving, emission reduction and environmental protection, electric vehicles have become a hot spot in the development of automobile technology. Based on the stiffness of the lower box, the box is optimized and verified by modal analysis. The analysis results show that the stiffness of the box can be increased by adding X type stiffeners at the bottom of the box, and the designed power battery box can meet the actual safety requirements of the car.

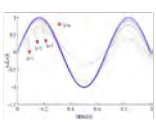
Power battery housing

ThPo1_3(17) 09:50-10:20

Iterative learning control for conformable fractional order system with time delay

Wang Yugang; Mingwen Yao; Cong Sun
College of Naval architecture and Marine Engineering Shandong Jiaotong University
Fengyu Zhou
School of Control Science and Engineering Shandong University/Beijing Advanced Innovation Center for Intelligent Robots and Systems, Beijing Institute of Technology

- Iterative learning control is applied to deal with a class of repetitive SISO conformable fractional order system
- The λ-norm and Gronwall inequality are applied to derive the convergence
- The influence of time delay is eliminated and the results illustrate the effective of the proposed method.



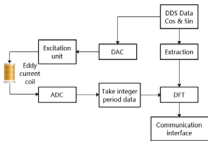
The tracking process of Example under ILC law

ThPo1_3(18) 09:50-10:20

DFT-Based Digital Signal Processing Algorithm Design for Eddy Current Testing Instrument

Shuangyin Wang*, Bo Tang, Qianfei Yang, Shaobin Shen , Ge Lin and Songhua Huang
CGN Inspection Technology Co., Ltd., 191 Yangpu Road, Suzhou 215012, China

- This paper designs a DFT-based digital signal processing algorithm for the eddy current testing instrument.
- This instrument is designed with FPGA, high-speed ADC, high-speed DAC, etc. Its core function is to obtain the frequency domain information.
- In this paper the method of solving DFT is based on correlation, rather than FFT.



Block diagram of data processing in eddy current testing instrument

ThPo1: Poster Session 1 (cont.)

Session Chair: Li Wen

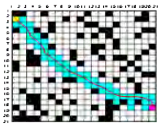
Room : Foyer, 1F, 10:00-10:30, Thursday, July 28

ThPo1_4(19) 09:50-10:20

Mobile Robot Path Planning Method Based on an Improved A* Algorithm

Ning Wang and Ting Wang
State Key Laboratory of Robotics, Shenyang Institute of Automation Chinese Academy of Sciences, China.
Zhihui Zhang
Artificial intelligence college , Shenyang University of Technology, China

- This papper prevent the A* algorithm from searching unnecessary expansion nodes.
- This method optimizes the diagonal path.
- In this paper, A* algorithm and Bezier curve are fused.
- This method eliminate paths with several large corners.

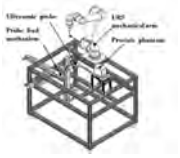


ThPo1_4(20) 09:50-10:20

Design of prostate puncture system guided by 3D MRI and TRUS images

Dong Liu, Long Wang, Xuefei Wang and Ming Cong
College of Mechanical Engineering, Dalian University of Technology, China
Yu Du
College of Mechanical Engineering, Dalian Jiaotong University, China
Deyong Yang
Urology Surgery, The First Affiliated Hospital of Dalian Medical University, China

- A robot system for prostate targeted puncture is designed.
- An automatic segmentation algorithm for prostate 3D MRI and TRUS images is proposed.
- A novel convolution module integrates residual connection, dense connection and deep separable convolution is proposed.



Structure diagram of prostate puncture system.

ThPo1_4(21) 09:50-10:20

A Camera Movement Guidance Method based on Multi-Object Tracking

Puchun Liu, Botao Li, Sheng Bi*, Muye Li and Chenxi Zheng
School of Computer Science and Engineering,
South China University of Technology, China

- Deploy a deep learning network model based on JDE for multi-object detection on edge side.
- Design an auto-spilt to split the model, with one part deployed on the edge side and the other on the cloud side.
- Design a camera motion model based on clustering algorithms to focus more of the targets.

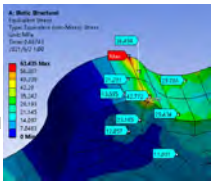
Detection results of JDE in our video

ThPo1_4(22) 09:50-10:20

Simulation Analysis of Contract Stress of Cycloidal-Pin Gear

Lanying Xu, Guoshan Ye, Qiang Wu, Sichen Feng
Guangdong Polytechnic Normal University, Guangzhou 510635, China.

- The meshing performance of cycloidal-pin gear transmission is the key factor affecting the transmission accuracy of high-precision
- Through the simulation nephogram, the regularities of distribution of contact stress and strain in the meshing process of cycloidal-pin gear is discovered
- The position of the maximum stress is on the upper edge of the meshing area of the cycloidal wheel and the pin teeth



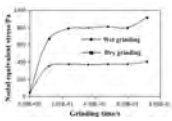
Local enlarged drawing of the maximum stress position of the cycloidal wheel

ThPo1_4(23) 09:50-10:20

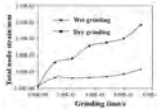
Simulation analysis of temperature field and stress-strain in form grinding of cycloidal gear

Lanying Xu, Sichen Feng, Guo-shan Ye, Qiang Wu
Guangdong Polytechnic Normal University, Guangzhou 510635, China.

- with the help of finite element analysis software, the transient temperature field and transient stress-strain field of tooth surface are simulated and analyzed respectively
- At the beginning of grinding, the equivalent stress and strain values of the nodes rise rapidly,
- In the middle of grinding, the equivalent stress and strain values of nodes continue to rise, but the rising speed is slower than that in the early grinding
- At the end of grinding, the stress and strain values of joints still have a small range of upward



(a)Stress change curve



(b)Strain change curve

ThPo1_4(24) 09:50-10:20

Development of an Economical 3D Sensor for Weld Seam Tracking in Robotic Welding

Heping Chen*, Henry Okeke*, and Biao Zhang#
*Ingram School of Engineering, Texas State University, USA
ABB Corporate Research Center, ABB Inc. USA

- Achieving quality weld in robotic arc welding processes is challenge due to workpiece fixture accuracy and variation in workpiece manufacturing processes.
- An economical 3D sensor is developed consisting of an inexpensive camera and a cheap laser generator for seam tracking..
- The welding results showed that it is promising for this economical sensor to be implemented for seam tracking in robotic welding.

ThPo1: Poster Session 1 (cont.)

Session Chair: Li Wen

Room : Foyer, 1F, 10:00-10:30, Thursday, July 28

ThPo1_5(25) 09:50-10:20

Design of Humanoid Robotic Hand Based on Link Underactuation

ZHANG Pu, DU Rui-long, et al
Zhejianglab, Hangzhou ,China

- The robotic hand has 7 degrees of freedom and 15 joints;
- The actuators are placed into the palm of the hand;
- The fingers are driven by linkages and are self-locking with worm gears.
- The robotic hand shows good adaptability to different grasp types.

ThPo1_5(26) 09:50-10:20

Optimization Method of Black Start Path for Offshore Wind Farm Considering Operating State of Turbines

Haitao Jiang, Chenggen Xu, Yuanming Zeng
China Guangdong Nuclear Power Rudong Offshore Wind Power Company
Hongyu Yang, Kaiyuan Huang
Jiangsu Frontier Electric Power Technology Company, the School of Electrical Engineering, Southeast University and with Nanjing Dongbo Smart Energy Research Institute

- This method firstly conducts data-driven modeling of the normal operating state of the wind turbine with the LSTM network.
- Then uses the actual data and the residual error predicted by the model to evaluate the operating state of the wind turbine, and divides the turbine into three categories.
- Finally, the electrical distance evaluation for the black-start of offshore wind power is based on the two goals.

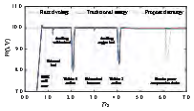
Optimization results of black start path for offshore wind farms

ThPo1_5(27) 09:50-10:20

Research on Black Start Coordinated Control Technology of Offshore Wind Power, Diesel, and Storage Combined System

Chao Yuan, Hongyu Yang, Yanan Liu, Yiming Tang
Jiangsu Frontier Electric Power Technology Company, China
Kaiyuan Huang
the School of Electrical Engineering, Southeast University and with Nanjing Dongbo Smart Energy Research Institute, China

- This paper proposes an improved BESS startup strategy to achieve zero voltage start reducing the inrush current of the system.
- Then the method of using auxiliary power supply to realize the start of the wind farm is given, which realizes the start of BESS, diesel engine, and wind turbines in turn.
- Finally, the reactive power coordination control strategy is proposed to improve the control link of the BESS, and the control strategy of wind turbine phase modulation operation is used to improve the voltage quality of the system.



Simulation of PCC point voltage during the black start process of wind farm

ThPo1_5(28) 09:50-10:20

Network Security Analysis Method for Power System

Liang Gu, Yi An, and Xin Zhou
Information and Communications Branch in State Grid Shanxi Electric Power Company, China

- Encode non digital features into digital ones
- The data conforms to the standard normal distribution through data standardization
- The null value and infinite value are eliminated in the process of standardization

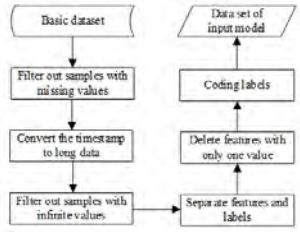


Figure 1. Flow chart of data preprocessing

ThA1: Best Paper Session I

Session Chair: Li Wen

Room : Tianchi 1, 1/F, 10:30-12:00, Thursday, July 28

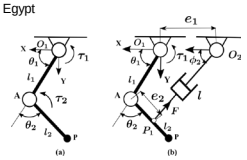
ThA1(1) 10:20-10:35

Modeling and Hybrid Compliant Control for a 2-DOF Robotic Leg With a New Biarticular Actuation

Abdonoor Kalibala, Abdelfatah Mohamed, Shinjiro Umezu and Samy F. M. Assal

Mechatronics and Robotics Engineering Department, Egypt-Japan University of Science and Technology (E-JUST), Egypt

- A new bio-inspired bi-articular actuation configuration with mono-articular rotary actuation and bi-articular linear actuation is developed for robotic leg.
- Full kinematic and dynamic analyses are developed in the bi-articular coordinates.
- A unified framework for a hybrid impedance and position controller is developed in the rotating task space.
- Simulation results prove the effectiveness of the proposed approach.



Schematic of two-link robotic leg with (a) Conventional independent mono-articular actuation (b) New mono-articular and bi-articular actuation

ThA1(2) 10:35-10:50

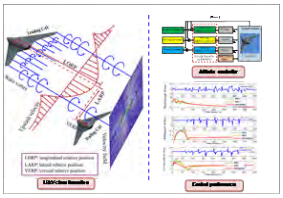
Active Disturbance Rejection Controller via Dynamic Weighted Mutant Pigeon-Inspired Optimization for UAV Close Formation Flight

Guangsong Yuan[1], Haibin Duan[1,*], Yongbin Sun[2] ,Chen Wei[1]

[1]School of Automation Science and Electrical Engineering, Beihang University, China

[2]Institute of Artificial Intelligence, University of Science and Technology Beijing, China

- Influence of the wake vortex on the attitude of trailing UAV
- Design of attitude controller using active disturbance rejection control
- Dynamic weighted mutant pigeon-inspired optimization



UAV close formation flight

ThA1(3) 10:50-11:05

The Region-based Virtual Fixtures Control for Invasive Avoidance in Hands-on Robot-assisted Mandibular Angle Split Osteotomy

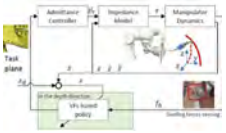
Huanyu Tian, Zhe Han, Dongsheng Xie, Xingguang Duan

Beijing Advanced Innovation Center for Intelligent Robots and Systems, Beijing Institute of Technology, China

Xi Fu, Feng Niu

Department of Craniomaxillofacial Surgery, Plastic Surgery Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College,China

- A feasible and efficient regional virtual fixture is established to describe the forbidden area in RAMASO.
- An admittance control-based strategy is proposed to avoid deep bone surface penetration distances.



The virtual fixture control for Hands-on robot system

ThA1(4) 11:05-11:20

Robust Platoon Control of Industrial Heavy-Load Autonomous Vehicles

Zhe Liu, Xiang Li and Hesheng Wang

Shanghai Jiao Tong University, China

Xiang Li

China University of Geosciences, China

- We consider the platoon control task of heavy-load autonomous vehicles from the view-point of practical industrial applications
- A fully distributed control law is presented, which only requires the coupling information of the two nearest neighbors
- We provide real experiments using full-scale industrial heavy-load vehicles to demonstrate our effectiveness and robustness.

Full-scale industrial heavy-load vehicles

ThA1(5) 11:20-11:35

Development of a Redundant Humanoid Lower Limb With Whole-Foot Tactile Perception

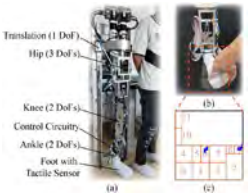
Funing Hou and Shijie Guo

Academy for Engineering and Technology, Fudan University, China

Jixiao Liu, Dicai Chen, and Kuo Liu

School of Mechanical Engineering, Hebei University of Technology, China

- The mechanism and the inverse kinematics algorithm of a humanoid lower limb with eight DoFs.
- A tactile sensor wrapping around the whole foot and a circuit integrating sensing and control.
- A mapping relationship between the control commands and the contact information to realize teaching-playback functions.



Humanoid lower limb.
(a) Structure. (b)-(c) Motion control by foot tactile information.

ThA1(6) 11:35-11:50

Human Inspired Robot Learning to Search Objects in Cluttered Environments Using Maximum Information-based Method

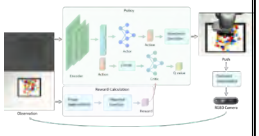
Zhihao Li, Shuaishuai Zheng, Zhipeng Dong and Fei Chen

Department of Mechanical and Automation Engineering, The Chinese University of Hong Kong, Hong Kong, China

Miao Li

Institute of Technological Sciences, Wuhan University, China

- Search objects in clutter is challenging for robots because of the uncertainty and unobservability.
- Humans search the object in the principle of obtaining more information.
- Design an objective function that enables robots to imitate the human search policy.
- Use model-free reinforcement learning to maximize the human inspired objective function.



The proposed search policy takes RGBD images as input and inferences push actions to find target objects in the cluttered environment.

ThB2: Perception and Recognition I

Session Chair: Hao Sun

Room : Songjiang, 2F, 13:05-14:35, Thursday, July 28

ThB2(1) 13:30-13:45

Unsupervised Domain Adaptive Object Detection Based on Frequency Domain Adjustment and Pixel-Level Feature Fusion

Yanlong Xu[1,2], Huijie Fan[2,*], Hao Pan[1], Lianquan Wu[3] and Yandong Tang[2]

[1] Shenyang University of Chemical Technology, China.
[2] Shenyang Institute of Automation, Chinese Academy of Sciences, China.
[3] Department of Police skills and Tactics Training, Criminal Investigation Police University of China, China.

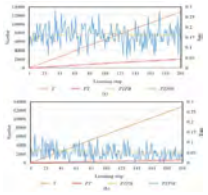
- Applying a trained model to a new unlabeled dataset will result in a dramatic degradation of model performance.
- We adopt an unsupervised domain adaptive approach to solve the problem of lacking annotated data sets.
- Fourier transform is introduced to adjust the images to reduce the domain offset.
- An improved adaptive feature fusion structure is introduced to enhance information fusion.

ThB2(2) 13:45-14:00

A High-efficient Training Strategy for Deep Q-learning Network Used in Robot Active Object Detection

Shaopeng Liu and Guohui Tian
School of Control Science and Engineering, Shandong University, China

- A high-efficient training strategy (HTS) for Deep Q-learning Network (DQN) is proposed
- HTS avoids repeatedly data with negative rewards during training DQN-based active object detection (AOD) model
- HTS combined with a built DQN-model outperforms other RL-based models in the AOD tasks
- The reason why HTS is better than the raw training algorithm (RST) of DQN is provided



The cures of training data analysis based the HTS (a) and RTS (b)

ThB2(3) 14:00-14:15

Sparse representation guided low-rank restoration for noisy image recognition

Zhenyu LI[1,2], Xi'ai CHEN[1,2], Jiaxin LIU[3], Chenyu ZHANG[1,2], Yong LI[4], Zhi HAN[1,2]
[1]State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, Shenyang
[2]Institutes for Robotics and Intelligent Manufacturing, Chinese Academy of Sciences, Shenyang
[3]State Grid Liaoning Electric Power Research Institute, Shenyang
[4]State Grid Shandong Electric Power Research Institute, Jinan

- A sparse representation-based recognition algorithm and a low-rank representation-based denoising algorithm are integrated into one model.
- Solving the problem of lack of information interaction between denoising and identification.
- We propose an optimization algorithm based on the alternating direction method of multipliers(ADMM).
- Our method is more robust and effective under high density noise compared with traditional recognition methods.

ThB2(4) 14:15-14:30

An Automatic Hand Rehabilitation Assessment System: Implementation and Experiments

Yifan Wang and Cheng Long
State Key laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Sciences, China

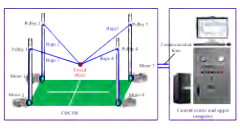
- An automatic hand rehabilitation assessment system based on hand gesture recognition and a self-designed hand strength measurement device.
- The system can realize all hand rehabilitation assessments in Fugl-Meyer Assessment (FMA) at home.
- The proposed system has the same reliability as the traditional FMA in hand function assessment according to 10 volunteer experiments.

ThB2(5) 14:30-14:45

Study of Control Method of a Rope-Driven Coordinative Towing Robot System

Xiaoyan LI
School of Railway Power, Shaanxi Railway Institute, China

- Firstly, the structural configuration and kinematics of RDCTR were introduced.
- The generalized dynamical model of the RDCTR was then established.
- A control strategy with the hybrid force/velocity control and the velocity compensator was proposed for the RDCTR.
- The control strategy was simulated and analyzed in the single rope driven unit and the RDCTR system.



The model of the RDCTR

ThB2(6) 14:45-15:00

Elderly walking model and micro Doppler feature extraction with millimeter wave radar

Xinchun Zhao, Jun Zhang and Yu Wang
Department Name, University Name, Country

- China has entered an aging society. More and more attention has been paid to the monitoring of the elderly at home. This paper presents a simplified Boulic walking model based on the walking gait of the elderly. A radar echo model based on millimeter wave radar is constructed for the model. In the experiment, the micro-Doppler characteristics of the model are obtained by using the short-time Fourier transform.

Human walking simulation

ThB3: Measurement and Prediction I

Session Chair: Zhi Han

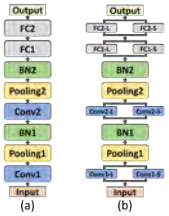
Room : Baishan 1, 2F, 13:05-14:35, Thursday, July 28

ThB3(1) 13:30-13:45

A Novel Lightweight Architecture of Deep Convolutional Neural Networks

Baichen Liu[1,2,3], Xi'ai Chen[1,2] , Zhi Han[1,2], Huidi Jia[1,2,3], Yandong Tang[1,2]
[1]State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, Shenyang
[2]Institutes for Robotics and Intelligent Manufacturing, Chinese Academy of Sciences, Shenyang
[3]University of Chinese Academy of Sciences, Beijing, 100049, China

- A novel low-rank and sparse architecture of deep convolutional neural networks to accelerate inference speed
- Easily implanted to popular deep convolutional neural networks for achieving better network performance
- We give an architecture selection guidance and weight initialization guidance of our designed network



ThB3(2) 13:45-14:00

Prediction of the Contrast between Target and Background based on an Improved Support Vector Machine

Junbo Liao, Hongxue Yuan, Huiru Zhong and Heng Li
China Huayin Ordnance Test Center, China
Xin Cai
School of Electrical Engineering, Xinjiang University, China
Jian Li and Yuliang Zhao
School of Control Engineering, Northeastern University, China

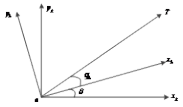
- Apparent temperature difference (ATD) between the target and the background is used as an alternative method to evaluate the infrared radiation contrast.
- A support vector machine (SVM) algorithm based on an improved PSO algorithm is proposed to predict the ATD of two different static targets based on long-term testing.
- Dynamic selection strategy based PSO is proposed to search the optimal parameters of SVM for improving the performance of SVM.

ThB3(3) 14:00-14:15

Analysis and Simulation of Influence of Attitude Error on Strapdown Seeker Angle Rate Extraction

Zhiman Liu and Yifei Wang
Changchun Automobile Industry Institute, Changchun 130013, China

- The relationship between navigation attitude error and extraction accuracy of line of sight angle rate of strapdown seeker is given.
- This paper takes an ammunition model with optical strapdown seeker as an example.
- The simulation results show that when the navigation attitude error is 5 degrees, the guidance accuracy will not be affected



The relationship between sight angle and body sight angle

ThB3(4) 14:15-14:30

Robotic Visual Inspection and Positioning Method for Flexible Wire Coating Operation

Chenglong Rao and Junpeng Wang
College of Information Engineering, Shenyang University of Chemical Technology, China
Yifeng Song, Hongguang Wangand Fengren Jing
Shenyang Institute of Automation, Chinese Academy of Sciences, China

- robot visual inspection and positioning method for flexible wire coating operation
- hand-eye calibration and camera calibration
- locate and track the dynamically changing target in real-time

Coating robot system

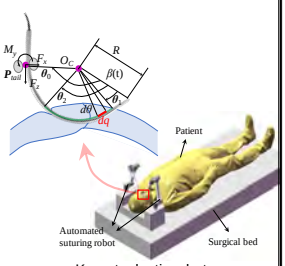
ThB3(5) 14:30-14:45

Research on Intraoperative Cornea-Instrument-Robot Interaction for Autonomous Cornea Suturing

Xiaojing Feng, Xiaodong Zhang, Xiaojun Shi
School of Mechanical Engineering,
Xi'an Jiaotong University
Shaanxi, China

Li Li
Department of Ophthalmology,
The First Affiliated Hospital of Xi'an Jiaotong University
Shaanxi, China

- Intraoperative cornea-instrument-robot interaction process while performing the corneal suturing are analyzed.
- Quantitative interaction model of the forces and torques for cornea-instrument-robot of keratoplasty is built.
- An intraoperative dynamic model of the keratoplasty robot is established to autonomously conduct corneal suturing.



Keroatoplastic robot

ThB3(6) 14:45-15:00

Kinematic Parameter Calibration method of Light Weight Robots Based on SQP Algorithm

Kang Min, Fenglei Ni*, Xin Shu, Zhu Ji and Hong Liu
The State Key Laboratory of Robotics and System, Harbin Institute of Technology (HIT), China

- The proposed method can significantly improve the positioning accuracy of the robot TCPs and is suitable for industrial applications
- The kinematic parameters errors are identified by SQP algorithm, which is not sensitive to noise
- The identified kinematic parameter errors are converted into joint angle errors for error compensation

Fig. 1 The experimental platform

ThB4: Robot Planning and Control I

Session Chair: Ziqiang Zhang

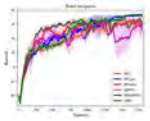
Room : Baishan 2, 2F, 13:05-14:35, Thursday, July 28

ThB4(1) 13:30-13:45

An Intelligent Robot Motion Planning Method and Application via LPPO

Lingli Yu and Jiawei Luo
School of Automation, Central South University, China
Kaijun Zhou
School of Computer and Information Engineering, Hunan University of Technology and Business, China

- An improved **end-to-end motion planning** algorithm with proximal policy optimization
- **Solving the problem of training failure** of proximal policy optimization algorithm
- **Improves the stability of the algorithm**
- **Improved algorithm obtains higher reward values** and the robot has **smoother motion control** while navigating obstacle avoidance

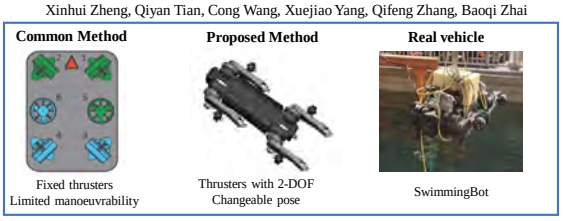


Reward curves in robotic navigation environments

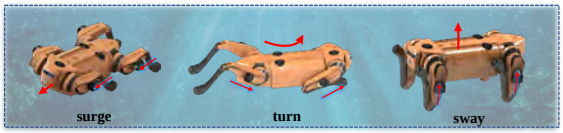
ThB4(2) 13:45-14:00

A Novel Thrust Allocation Method for Underwater Robots

Xinhui Zheng, Qiyan Tian, Cong Wang, Xuejiao Yang, Qifeng Zhang, Baoqi Zhai



The vehicle could adjust the joint angles to generate a max thrust in the desired direction, which realize high manoeuvrability and energy saving. Three poses are shown as follows.



ThB4(3) 14:00-14:15

Structure Design and Trajectory Planning Of Meal-assistance Robot

Chao Wang
School of Mechanical and Electrical Engineering, Harbin Engineering University, China

- Firstly, the structural of Meal-assistance was design.
- The generalized Kinematic model of the robot was then established.
- The motion trajectory of the robot was planned by quintic B-spline.
- Simulation result indicates that the robot's joint position, velocity and acceleration curves are smooth and continuous without vibration.

The model of Meal-assistance robot

ThB4(4) 14:15-14:30

Research on vision based outdoor blind guiding robot

Yanchen Guo , Lina Hao* and Yingli Wu
School of Mechanical Engineering and Automation, Northeastern University, China

- An improved artificial potential field method is used to elude obstacles on the guide robot
- The vision system of the guide robot uses Mobilenet_SSD detection algorithm to detect obstacles
- Binocular ranging combined with Mobilenet_SSD detection algorithm realizes obstacle identification and ranging

The scene of the guide experiment

ThB4(5) 14:30-14:45

Obstacle Detection and Path Planning for Intelligent Overhead Cranes Using Dual 3D LiDARs in a Brewing Environment

Tonglei Jiang Guoliang Liu and Qinghui Zhang
School of Control Science and Engineering, Shandong University, China
Zheng Zeng
Machinery Technology Development Co. Ltd. , China
Sujun Cheng
School of Physics and Electronic Engineering, Xinxiang University, China
Jianhua Zhang
School of Mechanical Engineering, Hebei University of Technology, China
Yuhang Zhang
Hebei Hengshui Laobaigan Wine Co. Ltd. , China

- A horizontal installation layout scheme of dual LiDARs in a Brewing Environment
- a path planning method adapt to the kinematic model of the crane

ThPo2: Poster Session 2

Session Chair: Li Wen

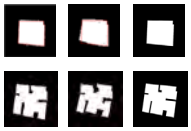
Room : Foyer, 1F, 14:35-15:05, Thursday, July 28

ThPo2(1) 15:00-15:30

Evaluation and Comparison of Gmapping and Karto SLAM Systems

Shengshu Liu, Yixing Lei and Xin Dong
Department of Mechanical, Materials and Manufacturing Engineering, University of Nottingham, United Kingdom

- Gmapping outperforms Karto in both localization and mapping.
- But the high quantity of particle usage demands more computational load than Karto.
- Therefore, Gmapping is suitable for complex environments with demanding accuracy requirements
- and Karto would suffice if the environment is simple and the accuracy requirement is undemanding.



Mapping results of the optimum parameter setting for Gmapping and Karto

ThPo2(2) 15:00-15:30

Design of a Multi-connection Pneumatic Artificial Muscle

Shixin Zhang and Daoxiong Gong
Faculty of Information Technology, Beijing University of Technology, China
Jianjun Yu
Faculty of Information Technology, Beijing University of Technology, China

- MPAM is formed by the combination of six pneumatic muscle fibers.
- MPAM is only 35g, and the thickest part is 3.5cm.
- MPAM's maximum contraction force is about 108N, the maximum contraction ratio is 28%.
- MPAM can recruit different amounts of muscle fibers depending on the situation.

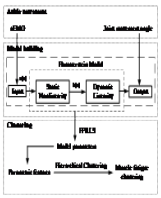
Physical design of MPAM

ThPo2(3) 15:00-15:30

EMG-based Assessment of Shank Muscle Fatigue During Dynamic Exercise

Huiqi Niu, Lizhong Zhu, Tao Cheng, Xu Zhong, Jiwei Li, Bi Zhang, Xingang Zhao
College of Automation and Electrical Engineering, Shenyang Ligong University.
State Key Lab of Robotics, Shenyang Institute of Automation

- An algorithm that can classify fatigue levels is proposed.
- Building a neuromusculoskeletal Hammerstein model.
- Analyzing the changes of model parameters in the fatigue process and establish an algorithm



Fatigue Assessment Algorithm Research Framework

ThPo2(4) 15:00-15:30

6DoF-ICTC: A Deep Image Feature Extraction Network Combining Transformers and CNNs for 6DoF Pose Estimation

Liming Zhang, Xin Zhou, Can Wang, Xinyu Wu
Shenzhen Institutes of Advanced Technology, China
Baixian Zhu
University of Science and Technology of China

Our contributions are as follows:

- A lightweight encoder-decoder architecture is proposed to extract global features of images employing self-masking.
- The model using Transformer in conjunction with CNN.
- The model uses Transformer to extract global features and CNN to extract local feature.

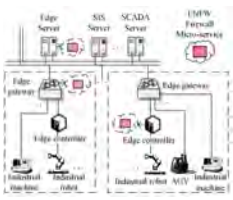
The model structure of ICTC.

ThPo2(5) 15:00-15:30

ENFW: an Industrial Firewall for Edge Computing

Guo Wu and Youdong Chen
School of Mechanical Engineering &Automation, Beihang University, Beijing, China
Guohua Zhang
BOCO Inter-Telecom Co.Ltd., Beijing, China

- Propose an industrial firewall framework called ENFW.
- Working as a firewall micro-service linked by the industrial firewall and the edge management centre.
- Integrating the heterogeneous industrial protocol parsing function and the general firewall function.
- ENFW outperforms traditional firewall in terms of performance.



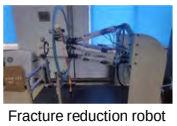
Deployment diagram of ENFW

ThPo2(6) 15:00-15:30

Study on the Master-slave Control System of the Fracture Reduction Surgery

Minghe Liu,Hao Sun, Yinglun Tan, Bokai Xuan, Xin Guo, Yuexuan Xu, Tianyi Ma ,Qingsong Ding
School of Artificial Intelligence and Data Science, Hebei University of Technology,China
Jian Li*
School of Automation, Beijing University of Posts and Telecommunications, China,

- The system was composed of teleoperation control and master hand operation control.
- A PID-Smith predictor was designed to compensate the network delay in the control process
- The SG algorithm was used to eliminate the physiological tremor when the doctor operated the master hand



Fracture reduction robot

ThPo2: Poster Session 2 (cont.)

Session Chair: Li Wen

Room : Foyer, 1F, 14:35-15:05, Thursday, July 28

ThPo2_2(7) 15:00-15:30

Option-based Multi-agent Exploration

Xuwei Song, Lipeng Wan, Zeyang Liu, Xingyu Chen, and Xuguang Lan
Institute of Artificial Intelligence and Robotics,
Xi'an Jiaotong University, China

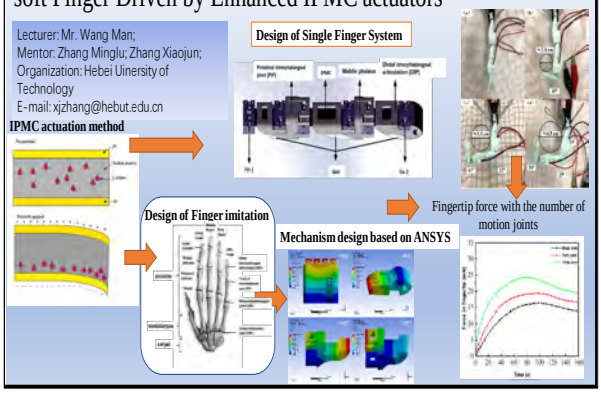
- We propose a method to improves multi-agent joint exploration through intrinsic options.
- We separate the exploration and the exploitation policies to ensure the CTDE paradigm.
- We propose a similarity estimation method to alleviate the distribution shift between two policies.

The training pipeline of our method.

ThPo2_2(8) 15:00-15:30

Research on Variable Stiffness of a Human-Inspired Rigid-soft Finger Driven by Enhanced IPMC actuators

Lecturer: Mr. Wang Man;
Mentor: Zhang Minglu; Zhang Xiaojun;
Organization: Hebei University of Technology
E-mail: xjzhang@hebut.edu.cn



ThPo2_2(9) 15:00-15:30

Research on demonstration task segmentation method based on multi-mode information

Wei Zhang, Tieze Cao*, Anbing Sun, Xiaochuan Gan, and Jingjing Fan
Changcheng Institute of Measurement & Metrology, 100095, Beijing, China
Lina Hao and Hongtai Cheng
School of Mechanical Engineering and Automation, Northeastern University, Shenyang, 110819, China.

- This paper proposes a segmentation method based on multimodal information.
- The demonstration task is preliminarily segmented by a method based on gestures, trajectory variance and contact force, and then the demonstration tasks are accurately segmented by fused segmentation criteria.
- Finally, the effectiveness of the proposed segmentation method is verified by reproducing the process of assembling planetary gear reducers.

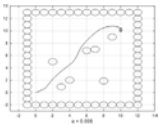
Experimental platform

ThPo2_2(10) 15:00-15:30

An Improved Dynamic Window Approach for Mobile Robot Dynamic Path Planning

Hongwei Qin and Shiliang Shao
State Key Laboratory of Robotics, Shenyang Institute of Automation Chinese Academy of Sciences, China.
Ting Wang
Institutes for Robotics and Intelligent Manufacturing, Chinese Academy of Sciences, China.

- This paper solves the weight problem of evaluation function in traditional DWA algorithm.
- This paper improves the performance of dynamic obstacle avoidance by solving the weight problem.
- A method to reduce the proportion of target course sub function is proposed.
- The simulation results show that the proposed method can avoid dynamic obstacles safely.

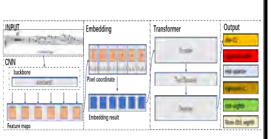


ThPo2_2(11) 15:00-15:30

Coordinate Embedding Transformer Model for Optical Music Recognition on Monophonic Scores

Changhai Zha, Zhiyong Huang*, Shiqiang Zhu, Jiakai Zhu, Ling Zhong, Ruilong Du
Intelligent Robot Research Center, Zhejiang Lab, China
Jason Gu
Department of Electrical Engineering, Dalhousie University, Halifax

- End-to-end optical music recognition on monophonic scores
- Using transformer model for OMR task for the first time
- Add the coordination information into the position encoder



Graphical scheme of the CETr model

ThPo2_2(12) 15:00-15:30

Preliminary exploration on the construction and application of knowledge graph for security control strategy

Wen Bo and Chen Yongxin
State Grid Hubei electric power research institute, Wuhan, China
Zhang Junhao
Southeast University, Nanjing, China

- Better management of strategy and realize the function of fast search
- By sorting out the relationship between the elements of security control strategy, and designing a structured knowledge network that can be presented and operated

knowledge graph for control strategy

ThPo2: Poster Session 2 (cont.)

Session Chair: Li Wen

Room : Foyer, 1F, 14:35-15:05, Thursday, July 28

ThPo2_3(13) 15:00-15:30

Research and Application of Standardization for Ship Energy Efficiency Intelligent Management Systems

Heng Li, Wei Liu and Shuhuan Feng
Ship Standardization Research Center, China Institute of Marine Technology & Economy, China

- Overview of ship energy efficiency intelligent management system
- Scheme design of standardized ship energy efficiency intelligent management system
- Current status and problems of the standard of ship energy efficiency intelligent management system
- Study on the standard requirements of energy efficiency intelligent management system for ships

Fig. Overall system framework

ThPo2_3(14) 15:00-15:30

Countermeasures for cramps in passive training of hand function rehabilitation robot

Kexin Zuo, Ben Wang, and Yangwei Wang, Member, IEEE
Northeast Forestry University, China

- Aiming at the problem of sudden cramps during finger rehabilitation using SMA wire actuation, a spasticity relief strategy based on existing medical methods was proposed. By improving the neural network PID control method, the hand function rehabilitation robot can pull the fingers with constant force. A series of experiments were designed to verify the feasibility. The experimental results show that the method can control the SMA wire to pull the patient's fingers with constant force, and it is effective in relieving cramps.

Hand Function Rehabilitation Robot

ThPo2_3(15) 15:00-15:30

Prediction of spraying process parameters based on BP neural network

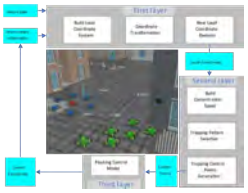
Abstract— In order to solve the problem that there are many process parameters in spraying process, which have complex influence on coating quality and have uncertain process parameters, a prediction method of spraying process parameters was proposed based on BP neural network algorithm. In the process of spraying, there are many factors that affect the quality of coating, and their interaction is complex, so it is difficult to find an accurate mathematical model in accordance with its rules. In this paper, BP neural network is used to establish the nonlinear mapping relationship between spraying process parameters and coating quality indexes, which is used as the prediction model of spraying process parameters. Taking ambient temperature, humidity, paint viscosity and film thickness as the input of neural network, and flow proportional valve pressure, atomization pressure and fan control pressure as the output, BP neural network model was established, and the prediction ability of the model was improved by optimizing the structure of the model. After optimizing the structure of BP neural network model, the prediction results show that the average relative error of flow proportional valve pressure is 0.4%. The average relative error of atomization pressure is 0.43%. The average relative error of sector control pressure is 0.61%. The established BP neural network model can meet the prediction requirements, and can clearly describe the relationship between environmental parameters, paint parameters, pressure parameters and coating quality, so as to better control the spraying process.

ThPo2_3(16) 15:00-15:30

A Cooperative Gene Regulatory Network Target Entrapping in GNSS-denied Environments

Ze Shi, Zhun Fan, Peili Ma, Juncao Hong, Wenji Li, Guijie Zhu, Huaxing Huang, Yuwei Cai, Zhaohui Dong
College of Engineering, Shantou University, China
Xiaomin Zhu
College of Systems Engineering, National University of Defense Technology, China

- For the GNSS-denied environment, a method for establishing a local coordinate system is proposed.
- For the entrapment task in a three-dimensional space, we design a new GRN model.
- Employing a flocking control algorithm to enhance the accuracy and robustness of the entrapment.



The framework of Co-GRN model

ThPo2_3(17) 15:00-15:30

Research on Point Cloud Noise Reduction Method based on Multi-Frame Fusion

Abstract— Aiming at the noise existing in the component point cloud model during the robot spraying process, a noise reduction method based on multi-frame point cloud fusion is proposed. First, establish a topology structure for the point cloud data; secondly, find the closest point based on the topology structure; finally, take the closest point in the point cloud as the corresponding point, and calculate the average value to complete the fusion of the point cloud and realize the noise reduction processing of the point cloud. . Taking the point cloud of plate class parts and right-angle class parts as the experimental objects, the experimental results show that after nine times point cloud fusions, the accuracy of the for plate class parts is improved by about 1.8 times ; for right-angle class parts, processing The large curvature part of the back point cloud does not appear over-smoothing. The algorithm achieves a good noise reduction effect and also preserves the high-frequency information of the point cloud。

ThPo2_3(18) 15:00-15:30

Research on Point Cloud Fine Registration Method Combined with Colored Grid Projection

Abstract— Aiming at the problem of low accuracy and large position deviation of component point cloud registration in the process of robot spraying, a point cloud fine registration method combined with colored grid projection is proposed. First, the topology of the point cloud is established; secondly, the overlapping part of the point cloud is obtained by finding the nearest point based on the established topology; third, color cluster the point clouds to find the key points; Finally, the corresponding point is found by the similarity between the position of the key point and the RGB value, and the point cloud fine registration is completed. Take the point cloud of the flat class parts and the freeform surfaces class parts as an example, the average distance between the corresponding points before the point cloud is finely registered is about 20mm, and the average distance between the corresponding points after the completion of the fine registration is about 3mm, and the accuracy of the point cloud meets the requirements of the robot intelligent spraying for the component point cloud model. The effectiveness and applicability of the proposed algorithm are verified

ThPo2: Poster Session 2 (cont.)

Session Chair: Li Wen

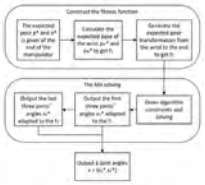
Room : Foyer, 1F, 14:35-15:05, Thursday, July 28

ThPo2_4(19) 15:00-15:30

Inverse kinematic solution method for a 6-DOF manipulator based on mayfly algorithm

Zhenyu Liu and Qin Zhang
The School of Electrical Engineering, University of Jinan, China
Hui Chai and Jiamin Guo
The School of Control Science and Engineering, Shandong University, China

- Solve the inverse kinematics problem of 6-DOF manipulator by using mayfly algorithm(MA).
- Design a separate fitness function according to the manipulator arm-wrist structure.
- Introduce an adaptive weight factor into MA to improve the algorithm performance.

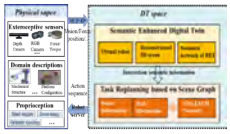


ThPo2_4(20) 15:00-15:30

Digital Twin-Driven Task Replanning Method for Robot-Environment Physical Interaction

Xin Li, Bin He, Zhipeng Wang, Yanmin Zhou and Gang Li
College of Electronics and Information Engineering, Tongji University, China

- This paper proposed a REI task replanning method using the scene graph and builds a real experimental scene to complete verification. The main contributions of this work are as follows:
- 1) a practical task replanning method of REI based on GNs-LSTM, which is capable of quickly obtain the atomic action sequence of the task, is proposed;
- 2) a lite REI task planning dataset is established.



The overall diagram of our proposed DT

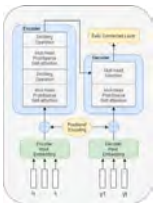
ThPo2_4(21) 15:00-15:30

A Novel Multi-Stream Informer Used for Lower Extremity Joint Angle Estimation

Xin Zhou, Liming Zhang, Jiaqing Liu,
Jiancong Ye, Can Wang and Xinyu Wu
Shenzhen Institutes of Advanced Technology, China

Our contributions are as follows:

- Sparse attention mechanism is introduced into the field of joint angle prediction.
- Multi-Stream informer is proposed.
- Achieve better results than state-of-the-art models.



The overall structure of MS-informer.

ThPo2_4(22) 15:00-15:30

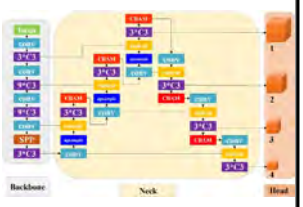
Multi-robot systems have great advantages and wide applications in the fields of ground reconnaissance, environmental monitoring, and key area patrols. However, in the field of multi-robot collaboration, it is difficult to take into account the patrol efficiency and path privacy simultaneously, especially when any intelligent intruders happen. To conquer the above difficulty, path randomness is proposed as a criterion to establish a multi-robot cooperative path planning model based on idle time dispersion, so as the path information privacy and security in the patrol process can be protected. In order to get the solution of the model, the index of idle time dispersion is introduced to get a tailored ant colony algorithm. Finally, patrol paths of multi mobile robots with high security are obtained. Several simulations in the simple road network and complex road network are conducted to verify the feasibility and effectiveness of the proposed method.

ThPo2_4(23) 15:00-15:30

Automatic Pavement Crack Detection Based on YOLOv5-AH

Zhaohui Dong, Guijie Zhu, Zhun Fan, Jiacheng Liu, Huanlin Li, Yuwei Cai, Huaxing Huang, Ze Shi, Weibo Ning and Liu Wang
College of Engineering, Shantou University

- 1) Use a mobile robot to collect crack images on pavement and establish an image dataset
- 2) Introduce the attention mechanism and one more prediction head to improve the robustness and generalization of our model.
- 3) YOLOv5-AH achieve excellent performance on pavement crack dataset in both detection accuracy and detection speed.



The network architecture of YOLOv5-AH.

ThPo2_4(24) 15:00-15:30

Design of An Ankle-Foot System with Uneven Terrain Adaptability

Fangyan Shen[1*], Ruilong Du[1*], Daming Nie[1],
Zhiyong Huang[1], Jiangren Tian[1] and Jason GU[2]
1. Zhejiang Lab, Hangzhou, China
2. Department of Electrical Engineering, Dalhousie University, Canada

- Developed an ankle-foot system for bipedal robots to walk on uneven terrain
- Developed sensing system for ankle-foot system to realize uneven terrain perception
- Developed control system for ankle-foot system to realize uneven terrain adaptation
- Conducted three experiments to the ankle-foot system prototype and verified the uneven terrain adaptation ability

Ankle-foot system prototype and uneven terrain adaptation experiment

ThPo2: Poster Session 2 (cont.)

Session Chair: Li Wen

Room : Foyer, 1F, 14:35-15:05, Thursday, July 28

ThPo2_5(25) 15:00-15:30

Design and Implementation of a Control System for Wrist Offset Wheel Hub Polishing Robot

Kui Zhu, Lijun Zhao, Zhiheng Liu and Yi Xia
State Key Laboratory of Robotics
and Systems, Harbin Institute of Technology, China

- Oriented to the grinding and polishing robot with offset wrist
- Cooperative design method of the software and hardware control system
- Based on EtherCAT
- Human-computer interaction for grinding and polishing system

ThPo2_5(26) 15:00-15:30

A FOPID-IGPC Control Method for Bulb Tubular Turbine Generator Unit

Aimin An, Yongan Wen and Rongxin WangFirstName LastName
College of Electrical Engineering and Information Engineering,
Lanzhou University of Technology, China

- Bulb Tubular Turbine Generator Unit (BTTGU) as an ideal generation equipment for developing power resources of low head water, it has the advantages of high efficiency, high overflow, small investment, short construction period. Therefore, it is of great practical significance to master its operating characteristics and improve its control performance.
- A block modeling approach is used to model each of the four subsystems of the regulation system. When the unit wears out or the system working condition changes, the traditional PID controller parameters cannot guarantee good control performance of the system.
- Fractional-Order PID Implicit Generalized Predictive Control (FOPID-IGPC) controller is designed to improve the control performance of the system. The effectiveness of the proposed FOPID-IGPC control strategy was verified by start-up scenario, frequency tracking scenario and load dumping test scenario.

ThPo2_5(27) 15:00-15:30

A Method for Identifying Spatial Distribution Parameter Fields of Composite Materials Based on Modal Functions

Li Fan, Xiongzi Li and Zhongxue Gan
Engineering Research Center for Intelligent Robotics
Ji Hua Laboratory
Foshan, Guangdong, China

- The mechanical parameters of composite materials often exhibit non-uniform characteristics with spatial distribution.
- Aiming at non-uniformity, this paper proposes a method to identify the spatial distribution parameters of composite materials based on modal superposition and orthogonal polynomial expansion.
- The results show that the algorithm in this paper can accurately identify the parameters of composite materials with non-uniform distribution in space, and has a relatively high identification accuracy in the presence of experimental noise. This method can provide more accurate material parameters for modeling heterogeneous composite materials.

ThPo2_5(28) 15:00-15:30

An Attention Based Chinese Sign Language Recognition Method Using sEMG Signal

Zhen Zeng and Fei Wang
Faculty of Robot Science and Engineering, Northeastern University, China.

- Proposed an Attention Based Chinese Sign Language Recognition Method which is able to recognize Chinese sign language from sEMG multi-modal data.
- Introducing SE-Block and LSTM for parsing the temporal features of sign languages
- Our method achieves better accuracy performance and real-time performance.

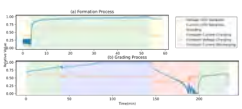
Model structure of our method

ThPo2_5(29) 15:00-15:30

Prediction of Battery Capacity Based on Deep Residual Network

Yankui Wang, Wenhao Yao, Min Dong*,
Yixuan Li, Longxing Zhu and Sheng Bi
School of Computer Science & Engineering,
South China University of Technology, China

- Propose an end-to-end battery capacity prediction model based on Deep Residual Network.
- Design a fusion model to better improve the model's accuracy.
- More than 98% of predictions has an error less than 10mAh.
- Visualize the extracted data features in the middle layer of network.



Battery voltage and current in charging process

ThC2: Perception and Recognition II

Session Chair: Ningbo Yu

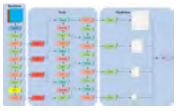
Room : Songjiang, 2F, 15:05-16:35, Thursday, July 28

ThC2(1) 15:30-15:45

SIP-YOLOv5: A Road Negative Obstacle Detection Network Based on Improved YOLOv5 and Prediction Box Correction Algorithm

Fan Zhang, Hanwei Peng and Lingli Yu
School of Automation, Central South University, China

- Propose a SIP-YOLOv5 network to detect negative obstacles
- Add a small object detection layer and improved coordinate attention based on YOLOv5m
- Design a prediction box correction algorithm to correct the detection results
- SIP-YOLOv5 improves AP0.5 by 5.4% and AP05:0.95 by 1.7% compared to YOLOv5m



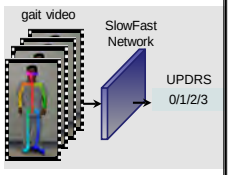
The structure of SIP-YOLOv5

ThC2(2) 15:45-16:00

SlowFast Network for Quantification of Parkinsonian Gait using MDS-UPDRS videos

Qingyi Zeng, Peipei Liu, Ying Bai, Huan Yu, Xiaoyi Sun, Jianda Han, Jialing Wu* and Ningbo Yu*
College of Artificial Intelligence, Nankai University, China
Department of Neurology, Tianjin Huanhu Hospital, China
State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, China

- The SlowFast GCN network is proposed to quantify the Parkinsonian gait disorders.
- Two healthy control groups are used to investigate the age effect on the classification performance.
- The proposed model provide a potential remote diagnosis method convenient for clinical application.

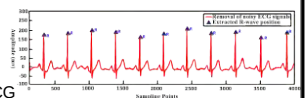


ThC2(3) 16:00-16:15

•ECG Feature Wave Recognition Based on Adaptive Wavelet Thresholding Algorithm

Meichun Wang
School of Instrument Science and Opto-Electronics Engi-neering, Beijing Information Science and Technology University, Beijing, China;
Peng Su*, Qiang Guo, Sikai Wang and Qinran Zhang
School of Mechanical and Electrical Engineering, Beijing Information Science and Technology University, Beijing, China;
Peili Wang
Cardiovascular Disease Center, Xiyuan Hospital, Chinese Academy of Traditional Chinese Medicine, Beijing, China;

- ECG signal denoising processing
- R-wave feature recognition algorithm
- MIT-BIH database algorithm verified
- Analysis of experimental results of ECG signal feature recognition



Adaptive wavelet thresholding algorithm feature extraction results

ThC2(4) 16:15-16:30

The Performance Of A Novel P300 Brain-Computer Interface Paradigm With Electrical And Vibration Modes

Chenxi Chu, Jingjing Luo, Qiang Du and Shijie Guo
Institute of Artificial Intelligence (AI) and Robotics, Fudan University, China
Xiangke Han
Department of the State Key Laboratory of Reliability and Intelligence of Electrical Equipment, Hebei University of Technology, China

- A Novel Tactile-stimuli P300 Paradigm
- Two Tactile Modes
- Similar Performances Of High Classification Accuracy(95.21% on vibration mode and 94.88% on electrical mode)
- Different Performances Of Stability(STD and Brain Connectivity)
- Discussions On Application Of The Two Tactile Modes

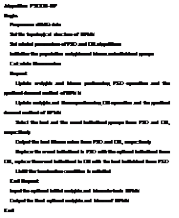
A Novel Tactile-stimuli P300 Paradigm

ThC2(5) 16:30-16:45

A Novel Hand Gesture Recognition Method Using sEMG-Based PSODE-BPNN

Ling-Long Li, Guang-Zhong Cao*, Senior Member, IEEE, Yue-Peng Zhang, and Jiang-Cheng Chen
Guangdong Key Laboratory of Electromagnetic Control and Intelligent Robots, College of Mechatronics and Control Engineering, Shenzhen University, China

- Propose a novel sEMG-based PSODE-BPNN method to optimize BPNN for hand gesture recognition.
- The parameters weights and biases of BPNN are updated and optimized by PSO and DE combining with gradient descent method.
- Evaluate the PSODE-BPNN on sEMG-based hand gesture dataset Ninapro DB4. The method improves the inadequacy of slow convergence rate and local minimum of BPNN, achieves higher gesture recognition accuracy than BPNN, PSO-BPNN, and other previous competing methods.



The process of the proposed PSODE-BPNN

ThC2(6) 16:45-17:00

A Comparison of MM and MMM-SF by Brain Mapping and Practical Trials

Saeed Bahrami Moqadam and Ahmad Saleh Asheghabadi
Department of Mechanical Engineering, Tsinghua University, China
Farzaneh Norouzi and Nikki Akraminejad
Medical University of Mashhad, Iran
Department of Psychology, Ferdowsi University of Mashhad, Iran
Behruz Shiee Zadeh Yazdi and Jing Xu
Electrical and Biomedical Engineering, Sadjad University of Technology, Iran
Department of Mechanical Engineering, Tsinghua University, China

- Non-invasive sensory feedback
- Closed-loop control in bidirectional upper limb prosthesis
- Impact of the MM-SF and MMM-SF on daily routine activities
- Stimulated area in brain at upper limb amputees during practical tasks

ThC3: Measurement and Prediction II

Session Chair: Zhi Han

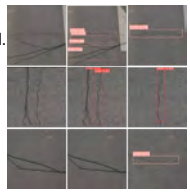
Room : Baishan 1, 2F, 15:05-16:35, Thursday, July 28

ThC3(1) 15:30-15:45

SRODNet:Pavement Crack Detection Based on Deep Convolutional Neural Network and Shadow Removal

Yide Zhang[1], Guoliang Liu[4] and Yichao Cao[5]
School of Control Science and Engineering, Shandong University, China
Zhihong Li[2] and Zilong Sun[3]
Yantai Highway Development Center, China

- Based on practical needs, a large-scale road disease dataset and shadow dataset are created.
- A road disease detection algorithm named SRODNet (Shadow Removal and Object Detection network) is proposed.
- SRODNet performs 9.7% precision and 3.5% mAP more than Yolov5.



From left to right: Input image, detection result of Yolov5 and detection result of SRODNet

ThC3(2) 15:45-16:00

A Kind of Nonlinear Disturbance Observer for Robotic Manipulator

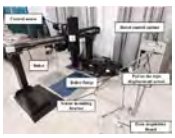
Name: Zhangfeilong
Affiliate: Shenyang Institute of Automation
Chinese Academy of Sciences

ThC3(3) 16:00-16:15

A Robot Coordinate Measurement System Based on Pull Wire Sensor and Its Parameter Identification Method

Shuang Gao, Kaiwei Ma, Yang Gao, Xin Shen and Fengyu Xu
the College of Automation & College of Artificial Intelligence, Nanjing University of Posts and Telecommunications, China
Mingxing Yang
the Anhui Province Key Laboratory of Special Heavy Load Robot, China

- Build a robot coordinate detection device
- Secondary error compensation using neural network
- The neural network structure is designed to optimize the compensation



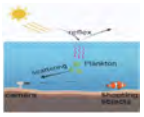
Robot experiment platform

ThC3(4) 16:15-16:30

Overview of Underwater Image Enhancement and Restoration Methods

Cheng Chenyu and Zhang Huiying
Information and Control Engineering, Jilin Institute of Chemical Technology, Jilin
Li Gang
Mechanical Control Engineering, Baicheng Normal University, Baicheng

- Several traditional image enhancement and restoration algorithms are introduced
- This paper focuses on the image enhancement and restoration algorithm based on deep learning
- Summarizes the existing public data sets in detail, introduces two mainstream objective evaluation systems, and finally looks forward to the future research.



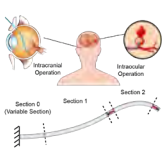
Underwater Image Imaging Model

ThC3(5) 16:30-16:45

Calibration of the Pseudo-rigid-body Model for a Multi-section Magnetic Catheter Robot

Daojing Lin, Niandong Jiao and Lianqing Liu
State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, China
Zhidong Wang
Department of Advanced Robotics, Chiba Institute of Technology, Japan

- A multi-section magnetic catheter robot with dexterous deformation capability for medical applications
- A pseudo-rigid-body (PRB) model to accurately describe the high-order deformation of the catheter robot
- A calibration method of the PRB model for the multi-section magnetic catheter robot

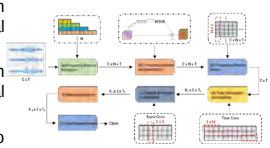


ThC3(6) 16:45-17:00

A Novel Motor Imagery EEG Classification Model Using Frequency-Temporal-Spatial Convolutional Neural Network with Channel Attention

Hong-Jie Liang, Ling-Long Li, Guang-Zhong Cao and Jiang-Cheng Chen
Guangdong Key Laboratory of Electromagnetic Control and Intelligent Robots, College of Mechatronics and Control Engineering, Shenzhen University, China

- Propose a novel MI EEG classification model of frequency-temporal-spatial multi-layer CNN with channel attention.
- Create multiple convolution kernels with different sizes on convolutional operation at each frequency band.
- Evaluate the proposed method on two MI EEG datasets, the classification performance is superior to state-of-the-art methods, and the effectiveness and superiority of the proposed method is validated.



The overall structure of the proposed model

ThC4: Robot Planning and Control II

Session Chair: Weidong Guo

Room : Baishan 2, 2F, 15:05-16:35, Thursday, July 28

ThC4(1) 15:30-15:45

3D Eye-to-Hand Coordination for Uninstructed Robot Grasp Planning

Peidong Liang, Chengxi Huang and Chentao Zhang
Fujian (Quanzhou)-HIT Research Institute of Engineering and Technology, China
Zhendong Fan and Lijun Zhao
State Key Laboratory of Robotics and System, Harbin Institute of Technology, China
Ruizhe Zhang
Department of Computer Science and Technology , Tsinghua University , China

- 3D eye-to-hand calibration
- 3D pointcloud data preprocessing
- Point cloud segmentation
- Uninstructed grasp planning

ThC4(2) 15:45-16:00

Path Planning Research for Outdoor Mobile Robot

Yujing Dong, Shuang Liu, Changzheng Zhang and Qigao Zhou
East China University of Science and Technology, China

- Present an improved A* algorithm based on road boundary constrainted
- It can be applied for road scenes such as campuses, communities, and industrial parks
- Reduce the influence of road boundaries when the mobile robot is moving outdoors

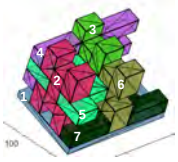
Mobile robot moving outdoor

ThC4(3) 16:00-16:15

Automatic Generation Of Stability Matrix For Assembly Sequence Planning

Trong Thien Vu, Zengxi Pan and Stephen Van Duin
Faculty of Engineering and Information Sciences (EIS),
University of Wollongong (UOW), Australia

- Assembly sequence planning needs to ensure feasible sequences, whereby each operation yields stable subassemblies.
- Stability matrix (SM) represents stability between every pair of parts in a subassembly.
- Our module automatically generates SM using:
  - physics-based approach: can handle friction
  - .STL file format: universal and light
- Validated using test cases with and without friction.



Woodblock subassembly on inclined surface

ThC4(4) 16:15-16:30

ZMP Preview Control of Lower Limb Exoskeleton Robot Based on 3D Linear Inverted Pendulum

Zhiwei Zhu

Abstract—In order to obtain the stable gait of lower limb exoskeleton robot, a gait generation method with zero force distance point (ZMP) compensation of preview control is proposed. According to the 3D linear inverted pendulum model and preview control theory, the inverted pendulum model is compensated by using the error between the actual ZMP and the target ZMP, and the centroid trajectory of the robot is planned, so that the three-dimensional linear inverted pendulum compensated ZMP preview control model has better ZMP tracking effect. Through programming and Simulation in Python, the effectiveness of the improved preview control and ZMP compensation optimization method to improve the inverted pendulum model is verified, and the stability margin of the lower limb exoskeleton robot in the walking process is improved.

ThC4(5) 16:30-16:45

Ordered Boundary Extraction Algorithm of 3D Point Cloud for Guiding Robot Spraying

The target digital model is provided for the robot controller through the three-dimensional reconstruction technology when the robot is guided by the visual system for intelligent spraying. In order to acquiring the reconstruction model of the target, the point cloud data obtained by the 3D vision sensor is processed by the 3D reconstruction technology. As an important geometric feature of the reconstruction model, the accurate extraction of the ordered boundary will be the core of the3D reconstruction technology. It is found that the current research on 3D reconstruction technology is generally to construct triangular meshes for discrete point clouds. However, in practice, the point clouds obtained from binocular stereo vision have matrix structure and can be directly converted to triangular meshes. However, the results contain large randomness and error when using grid characteristics to sort complex grid boundaries. To solve the above problems, we propose an integrated boundary extraction algorithm based on binocular stereo vision point cloud. The point cloud with matrix structure collected by binocular stereo camera is converted into point cloud with triangular mesh structure and the boundary is extracted according to the relationship between the edge and the triangle in the triangular mesh. It is stipulated that the searching of boundary must be found by the path containing the triangle in the boundary sorting so that the boundary search has a unique solution and provide a method to obtain an accurate and orderly boundary.

ThC4(6) 16:45-17:00

Manipulation Planning for an Mobile Manipulator with Positioning Error

Yuhao Meng, Tao Wang, Yujing Chen and Yunjiang Lou
School of Mechanical Engineering and Automation
Harbin Institute of Technology Shenzhen, Shenzhen, China.

- Design the overall scheme for the mobile manipulator and realize online planning.
- Proposed a manipulator operating capability map based on mobile platform positioning uncertainty.
- Proposed an accurate and safe manipulator pose planning algorithm based on the manipulator capability map.

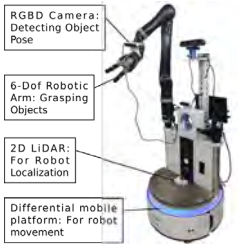


Fig: The mobile manipulator

ThC4: Robot Planning and Control II (cont.)

Session Chair: Weidong Guo

Room : Baishan 2, 2F, 15:05-16:35, Thursday, July 28

ThC4_2(7) 17:00-17:15

A Multiphysics Nanorobotic Manipulation System

Wenqi Zhang[1], Donglei Chen[1], Chaojian Hou[1], Kun Wang[1], Qingwei Li[2], and Lixin Dong[1,*]

[1]Department Biomedical Engineering, City University of Hong Kong, China
[2]School of Mechatronical Engineering, Beijing Institute of Technology, Beijing, China

- A multiphysics platform to augment the functions of both nanorobotic manipulation and in-situ transmission electron microscopy (TEM)
- Advanced capabilities on device prototyping and in-situ characterization such as atomic/elementary level structure analysis and sub-nm scale characterization
- Multiple physical stimuli such as particles, waves, fields, and forces

A nanorobotic manipulation system with multiple stimuli including light for in-situ TEM

Friday Sessions

FrPo3: Poster Session 3

Session Chair: Li Wen

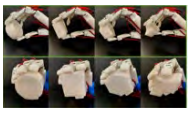
Room : Foyer, 1F, 10:30-11:00, Friday, July 29

FrPo3(1) 10:20−10:50

14 Degree IPMC Flexible Manipulator for Grasping

Zhang Xiaojun, Yu Sujun, Zhang Minglu, Li Manhong and Wang Man
School of Mechanical Engineering, Hebei University of Technology, China

- A 14 DOF bionic flexible manipulator based on IPMC actuator is designed
- The manipulator can grasp and pinch objects with the same weight and different shapes
- The bionic flexible manipulator shows good flexibility and adaptability



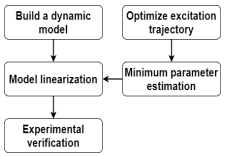
Pinch demonstration of objects with different shapes

FrPo3(2) 10:20−10:50

Dynamic Parameter Identification of Six-axis Industrial Robot Based on Improved Genetic Algorithm

Yan Li, Dawei Ni, Chengyu Wei, Zengpeng Lu, Zhenguo Zhang and Keping Liu
Department of Control Science and Engineering, Changchun University of Technology, China.

- To reduce the amount of calculation, the robot is simplified into two three-axis robots.
- Establish a linearized industrial robot dynamic model.
- Optimize the coefficients of excitation trajectory by the improved genetic algorithm.



Parameter identification flow chart

FrPo3(3) 10:20−10:50

Deep Residual Network for Image Super-Resolution Reconstruction

In this paper, an image super-resolution reconstruction method based on residual network is proposed. The sub-image is used as the input of the deep residual network, and then the residual network is improved by combining both local and global residual learning, which reduces the phenomenon of gradient disappearance and improves the efficiency of information transfer. The multi-scale convolution kernel is used to extract rich feature texture information for obtaining the reconstructed image. The experimental results indicate that the reconstruction effect of this method achieves better subjective visual experience and objective evaluation indicators than the contrasting algorithms.

FrPo3(4) 10:20−10:50

Design and Driving Rod Group Analysis of a Lower Limb Assisted Exoskeleton

Lingyan Zhao and Youan Tang and Xiaojun Wang and Zhiguang Guan
Engineering Machinery, Shandong Jiaotong University, China

- add passive joints and improve the passive joint structure
- improve the compatibility between exoskeleton and wearer's movement
- use the combined four-bar mechanism to solve the stress concentration of the driving mechanism

the lower limb exoskeleton robot mechanism

FrPo3(5) 10:20−10:50

Experimental Design of Self-Tracking Camera Gimbal Robot Based on OpenCV

Di Zhao[12*], Yuhong Du[3], Zhenyu Ding[4], Bo Yuan[5] and Yuxiang Wang[6]

(1.Engineering Teaching Practice And Training Center, National Experimental Teaching Demonstration Center of Engineering Training, Tiangong University, Tianjin 300387. 2. State Key Laboratory of Turbulence and Complex Systems, Laboratory of Intelligent Bionic Design, College of Engineering, Peking University, Beijing 100871. 3. Teaching Quality Monitoring and Evaluation Center, Tiangong University, Tianjin 300387. 4. Tiangong University, School of Electronic and Information Engineering, Tianjin 300387. 5. Tiangong University, School of Mechanical Engineering, Tianjin 300387. 6. Tiangong University, School of Electronic and Information Engineering, Tianjin 300387)

Abstract-The emergence of COVID-19 has reduced the opportunities for offline meetings, making people's work and study more transfer to the internet platform. However, the viewing angle and distance of the camera cannot be considered both.Therefore, machine vision is used to identify and track the presenter, and the camera pan-tilt control function of automatically tracking the presenter is realized. In many tests, the target tracking function works normally and works well. The experimental design involves relatively comprehensive disciplines, with good functional scalability and high practicability. It is an innovative experiment integrating robotics teaching, machine learning practice and embedded systems.

FrPo3(6) 10:20−10:50

Bionic Robotic Fish Mechanical Structure Optimization Design and Performance Analysis

Qunhong Tian[1,2,3*], Lixin Zhang[1], Acan Jiang[1], Hongbo Ma[4], and Yunxia Wang[1]
1. College of Mechanical and Electronic Engineering, Shandong University of Science and Technology, Qingdao, China;
2. Harbin Engineering University Qingdao Ship Science and Technology Co., Ltd., Qingdao, China;
3. College of Intelligent Systems Science and Engineering, Harbin Engineering University, Harbin, China;
4. State Grid Qingdao Huangdao District Power Supply Company, Qingdao,China

- The length of each segments for bionic robotic fish is selected as the decision variable;
- Based on the optimal segments, it establishes the optimization three-dimensional model for bionic robotic fish;
- Automatic Dynamic Analysis of Mechanical Systems is used for the performance analysis,
- Simulation results illustrate the effectiveness of mechanical structure optimization design.

Figure 1. The mechanical structure of the bionic robotic fish

FrPo3: Poster Session 3 (cont.)

Session Chair: Li Wen

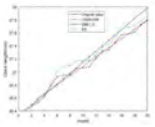
Room : Foyer, 1F, 10:30-11:00, Friday, July 29

FrPo3_2(7) 10:20-10:50

A Crack Prediction Method Based on Improved Grey System Model

Zhe Liu[1], Sile Ma[1,2], Xiangyuan Jiang[2], Yizhong Luan[2], Jiyang Chen[2,3], Xiaojing Ma[2]
1.School of Control Science and Engineering, Shandong University, Jinan 250061, China
2.Institute of Marine Science and Technology, Shandong University, Qingdao 266237, China
3.Shandong Zhengzhong Information Technology Co., LTD, Jinan 250014, China.

- Dam Crack Prediction
- Singer chaotic map and Levy flight optimization Sparrow Search Algorithm
- Improved grey prediction model
- The accuracy of fracture prediction is improved



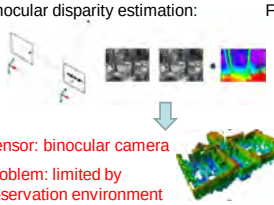
Comparison of algorithm prediction results

FrPo3_2(8) 10:20-10:50

Research on adaptive crawling of underwater hexapod robot on complex seabed

Yingzhe Sun
University of Chinese Academy of Sciences, Beijing, China
Qifeng Zhang, Qingfeng Yao and Aiqun Zhang
State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, Shenyang, China

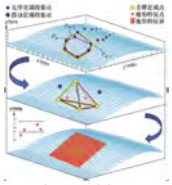
Binocular disparity estimation:



- Sensor: binocular camera
- Problem: limited by observation environment

3D occupancy map based on octree representation

Foot tip perception method:



- Sensor: foot end force sensor
- Advantages: strong adaptability

FrPo3_2(9) 10:20-10:50

Position Control of Traction Upper Limb Rehabilitation Robot Based on Fuzzy Sliding Mode Method

Wenxiang Zhang
School of Microelectronics and Control Engineering, Changzhou University, China
Linsen Xu
College of Mechanical and Electrical Engineering, Hohai University, China

- Traction upper limb rehabilitation Robot based on the omnidirectional platform.
- The simple structure and the enough training.
- Using fuzzy sliding mode method with power exponential reaching to reduce the chattering.

Physical exercise by the rehabilitation robot

FrPo3_2(10) 10:20-10:50

Research on wall transition control of double-body negative pressure wall-climbing robot

Wenjun Yan
School of Microelectronics and Control Engineering, Changzhou University, China
Linsen Xu
College of Mechanical and Electrical Engineering, Hohai University, China

- Establishment of kinematic and dynamic models.
- Design of quasi sliding mode controller with an improved reaching law.
- The RBFNN is used to learn the upper bound of the model's uncertain factors.

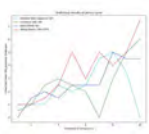
Double-body negative pressure wall-climbing robot

FrPo3_2(11) 10:20-10:50

Robot Confrontation Based on Policy-Space Response Oracles

Mingxi Hu and Siyu Xia
college of Artificial Intelligence, Nankai university, China
Chenheng Zhang and Xian Guo
college of Artificial Intelligence, Nankai university, China

- A novel and stable policy-space response oracles(PSRO) method is proposed.
- Our PSRO integrates α-Rank as the meta-strategy solver and CMA-EPPS as the oracles solver.
- The method performs better than IBR, fictitious play and PSRO with α-Rank and Best Response.



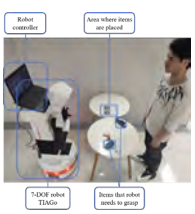
Statistical results of robot confrontation trained with different algrithms

FrPo3_2(12) 10:20-10:50

Motion Planning Combines Human Motion Prediction for Human-Robot Cooperation

Hejing Ling, Guoliang Liu, Liujuan Zhu, Bin huang, Fei Lu, Hao Wu and Guohui Tian
the school of Control Science and Engineering, Shandong University, China
Ze Ji
the school of Engineering, Cardiff University, UK

- This paper combines the user's head pose in a human-robot coexisting environment
- Prediction model based on LSTM predicts the wrist position
- We propose a motion planning algorithm combining human motion prediction



FrPo3: Poster Session 3 (cont.)

Session Chair: Li Wen

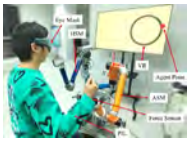
Room : Foyer, 1F, 10:30-11:00, Friday, July 29

FrPo3_3(13) 10:20−10:50

An Effective Training Strategy for Upper-limb Rehabilitation Robots Based on Visual-haptic Feedback Using Potential Field

Guang Feng and Lei Yang
School of Mechatronic Engineering and Automation, Shanghai University, China
Jiaji Zhang, Guohong Chai, Maoqin Li, and Guokun Zuo
Ningbo Institute of Materials Technology and Engineering, CAS, China

- Upper-limb rehabilitation robot
- Potential field control strategy based on a reference trajectory
- Visual-haptic feedback positively affected rehabilitation training



FrPo3_3(14) 10:20−10:50

A light knee exoskeleton for assisted ramp walking

Shaocong Chen[1,2,3], Shouqi Wei[1],Chunjie Chen[+2,3], Zhuo Wang[2,3], Yao Liu[2,3], Xin Ye[2,3], Lingxing Chen[2,3] and Xinyu Wu[2,3]

1.Guilin University of Electronic Technology, Guilin, China
2.Shenzhen Institute of Advanced Technology, Chinese Academy of Sci- ences, Shenzhen, China
3.Guangdong Provincial Key Lab of Robotics and Intelligent System, Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences

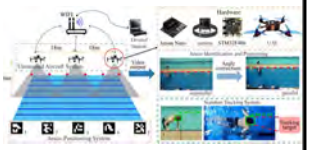
- Uses an embedded crossed four-link mechanism to simulate the polycentric movement
- The control unit can accurately distinguish the user's intention according to the user's attitude information
- Use different control strategies in different terrains, control the motor to generate accurate desired force

FrPo3_3(15) 10:20−10:50

RPAS: A Refined Positioning and Analysis System Based on Aerial Platform for Swimming Scenes

Shijie Zhang and Zhongquan Liu, Hao Wang, Fan Sang, Jiaxin Li, Yuxuan Guo, Xuan Pei,
Jianglong Zhang, Tao Tang and Taogang Hou*
School of Electronic and Information Engineering, Beijing Jiaotong University, Beijing, China.

- A **refined** positioning and analysis system based on **aerial platform** for **swimming scenes.**
- In static experiment, the **minimum position error** is **0.002m**, when the ground truth is 2.1m.
- The MAE is **0.0231m**, showing **high precision** of our method compared to IMU.
- **Great potential** in some **non-contact measurement scenes** of our method.



The full system of our method. It consists of the unmanned aircraft system, the aruco positioning system, and the siamban tracking system, which achieves a refined positioning results in swimming scenes.

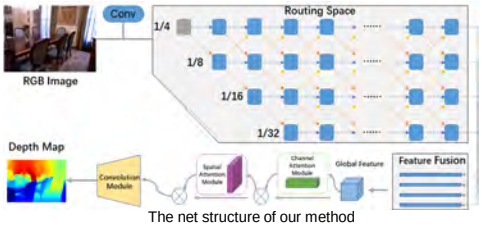
FrPo3_3(16) 10:20−10:50

A New Dynamic Routing Network for Monocular Depth Estimation

Zhehao Luo, Sijin Luo, Guoyuan Liang and Xinyu Wu
Shenzhen Institute of Advanced Technology, China

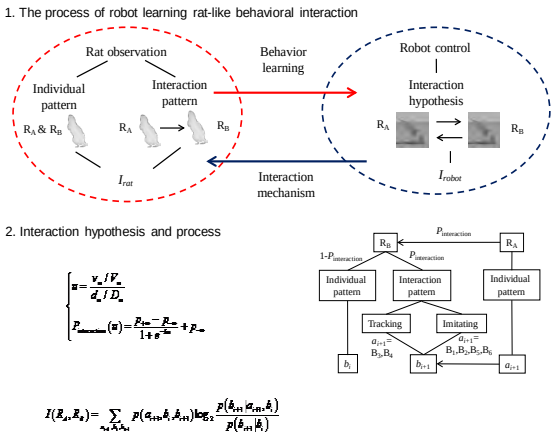
Our contributions are as follows:

- Dynamic network is introduced into the field of monocular depth estimation
- The model is more lightweight
- The proposed methods performs better in public datasets



The net structure of our method

FrPo3_3(17) 10:20−10:50

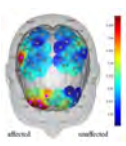


FrPo3_3(18) 10:20−10:50

Cortical reorganization pattern of stroke patients under upper limb multi-joint linkage task

Qitong Chu and Xin Guo*
Hebei University of Technology, China
Congcong Huo, Tengyu Zhang*, Xuemin Zhang, Gongcheng Xu and Huiyuan Li
National Research Center for Rehabilitation Technical Aids, China
Shengcui Cheng and Ping Xie*
Yanshan University, China

- Unilateral upper limbs with a multi-joint linkage task induce significant cortical activation in bilateral hemispheres.
- In stoke patients, greater cortical activation was observed compared with healthy controls during motor task.
- The connectivity of resting state significantly different between patients group and healthy group.



Difference of two groups in motor task

FrPo3: Poster Session 3 (cont.)

Session Chair: Li Wen

Room : Foyer, 1F, 10:30-11:00, Friday, July 29

FrPo3_4(19) 10:20-10:50

Research Status of Bathing Aids for the Elderly

Jianyi Zhang and Xinyang Zhao
Harbin University of Science and Technology , China
Lifang Ma
National Research Center for Rehabilitation Technical Aids, China
Jian Li*
Beijing University of Posts and Telecommunications , China

- The proportion of the elderly who cannot complete bathing by themselves is 90.8%
- A systematic review of current status of domestic and foreign bathing aids for the elderly
- It has reference significance for the development of bathing aids in the future

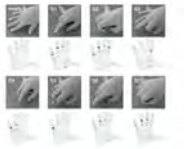
Bathing aids

FrPo3_4(20) 10:20-10:50

Multi-kernel-size Convolutional Supervised Autoencoders for Tactile Gesture Recognition

Chaoxiang Ye and Zhengkun Yi
Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, China

- We apply the SAE to solve the overfitting problem of the tactile gesture recognition task.
- We propose a novel MCSAE to further improve the generalization performance on a tactile gesture dataset.
- The experimental results demonstrate that SAE and MCSAE have better generalization performance than compared methods.



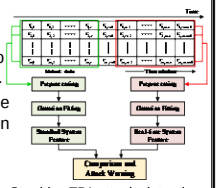
Tactile gesture dataset. Eight different gestures and their corresponding sensor arrays.

FrPo3_4(21) 10:20-10:50

Data Injection Attack Detection Method Based on Residual Distribution of State Estimation

Lei Zhu, He Huang and Song Gao
Jiangsu Electric Power Company, Nanjing, China
Jun Han and Chao Cai
State Grid Jiangsu Electric Power Company Economic Research Institute, Nanjing, China

- Stealthy FDI attack can bypass the bad data detection and thus trigger false commands.
- Residual distribution increases in density due to the injection attack without measurement noise.
- Gaussian fitting method is used to extract the characteristic parameters of residual distribution as system feature.
- Simulation results prove that the proposed attack detection method under a sliding time window is effectiveness and efficiency.



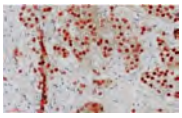
Stealthy FDI attack detection method based on the system feature

FrPo3_4(22) 10:20-10:50

A Method of Cell Counting Based on Computer Vision

Shihong Ding
Shenyang Ligong University,China
Huanyu Zhao
The First Affiliated Hospital of China Medical University,China
Zhi Han and Yandong Tang
Shenyang Institute of Automation,Chinese Academy of Sciences,China

- We collected the cell image of clinical medicine and the real data.
- We can solve the problems in identifying cells, difficulty in cell counting.



Count the stained cells (in black shape)

FrPo3_4(23) 10:20-10:50

LinesLiDAR Point-Cloud Odometer Based Mobile Robot Routine Tracking in Orchards

Quan Qiu
Academy of Artificial Intelligence, Beijing Institute of Petrochemical Technology, Beijing 102617, China
Xuefeng Li
Tianjin Research Institute of Construction Machinery, Tianjin 300000, Country

- We propose a center line tracking solution for the mobile robots in orchard, which employs LiDAR odometer to carry the positioning task and PID algorithm to implement the line tracking control task;
- Experiments are conducted in the practical orchard scenarios;
- The experimental results show that our solution can give good center line tracking performance, with a maximum localization error of 0.037 meters after marching 10 meters, mean lateral tracking deviation of 0.016 meters and mean orientation deviation of 2.505 degrees.

The robot in the orchard and the navigation experimental result

FrPo3_4(24) 10:20-10:50

Experimental study of a human-computer evaluation model based on the performance of surface electromyographic massage pillows

Jianyi Zhang, Wei Li, Shan Du,Xinyang Zhao,Haolin Sui
Harbin University of Science and Technology,China

- Human-computer evaluation model of massage pillow performance
- Time and frequency domain analysis of electromyography experiments
- Experimental flow of human-machine evaluation of massage pillow performance

Human-computer evaluation model of massage pillow performance

FrPo3: Poster Session 3 (cont.)

Session Chair: Li Wen

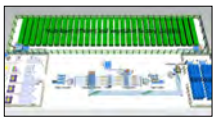
Room : Foyer, 1F, 10:30-11:00, Friday, July 29

FrPo3_5(25) 10:20-10:50

Low-carbon design of leafy vegetable production system based on life cycle analysis and digital model

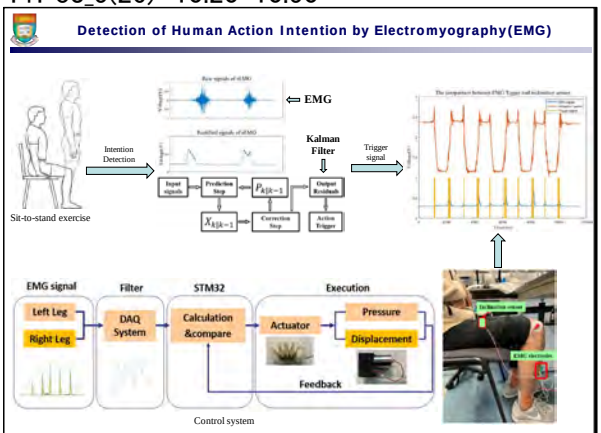
Guohua Gao, Xinyue Du, Zihua Zhang, Wenyue Liu, Shiyue Pan
Faculty of Materials and Manufacturing, Beijing University of Technology, China

- In the design stage of production system, capacity and carbon emissions should be considered.
- The carbon emission quantification model of production system was established based on life cycle analysis.
- Establish digital simulation model of production system
- Through multi-factor and multi-level experiment, the parameter relationship of production system is analyzed.



Digital simulation model of production system

FrPo3_5(26) 10:20-10:50



FrPo3_5(27) 10:20-10:50

Electric Vehicle Regulation Technology Based on Deep Reinforcement Learning

Zhujian Ou[1] , Xiaolong Xiao[2], Hang Yu[3], Jianhua Yuan[1], Xiaowei Miao[1],Dongdong Huang[1]

1.Nantong Power Supply Branch, 2.State Grid Jiangsu Electric Power Co., Ltd, 3.Southeast University

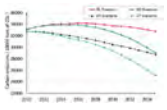
- This paper proposes an EV regulation method based on **deep reinforcement learning(DRL).** Through the management of charging and discharging of EV, while ensuring the stability of the voltage level of the distribution network, the network loss of the distribution network can be reduced.
- This method does not depend on the actual physical model and is more in line with the actual situation of the distribution network. Finally, the feasibility of the method is verified by simulation.

FrPo3_5(28) 10:20-10:50

A Simulation Based Investigation Considering Carbon Emissions in Shanghai

Peng Cheng, Mingxing Guo, Chen Fu, Su Wang and Li Lan
Shanghai Economic and Technological Research Institute, China
Yuetong Huang
Liyang Research Institute of Southeast University, China

- Based on Markov model and LEAP model to predict energy structure and energy demand
- Analyze the carbon emissions of Shanghai from 2019 to 2035 under different scenarios
- In the short term, industrial structure adjustment to carbon emissions reduction is the strongest
- In the long term, clean energy substitution has a significant effect on carbon emissions reduction.



Carbon emissions in Shanghai under different scenarios

FrA1: Best Paper Session II

Session Chair: Li Wen

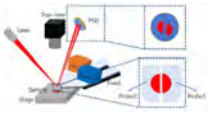
Room : Tianchi 1, 1/F, 11:00-12:30, Friday, July 29

FrA1(1) 10:50-11:05

Fast AFM probes switching method via Integrated dual-probes

Kaixuan Wang, Tie Yang, Jialin Shi, Peng Yu, Chanmin Su
State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, China
Lianqing Liu
State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, China

- An integrated dual-probe design based on a common probe
- A single optical path lever for sensing
- Fast AFM probes switching imaging



Schematic diagram of the AFM system for fast switching imaging using an integrated dual-probe

FrA1(2) 11:05-11:20

Robot Manipulation Skill Learning Based on Dynamic Movement Primitive

Yunfeng Bai[1, 2], Fengming Li[3], Man Zhao[1, 2], Wei Wang[1], Yibin Li[1, 2], and Rui Song[1, 2]

1. School of Control Science and Engineering, Shandong University, Jinan 250061, China
2. Engineering Research Center of Intelligent Unmanned System of Ministry of Education, Jinan 250061, China
3. School of Information and Electrical Engineering, Shandong Jianzhu University, Jinan 250101, China

- A robot automatic valve turning control strategy is proposed.
- The learning control system learns motor skills from demonstrations through DMP.
- The valve turning skills learned from human demonstration can be reproduced on the robot.

Valve turning experimental platform

FrA1(3) 11:20-11:35

Classification of Individual Finger Motions Using Single-Site Mechanomyography by Optimized Long Short-Time Memory

Ahmad Saleh Asheghabadi and Saeed Bahrami Moqadam and Jing Xu
Mechanical Engineering, Tsinghua University, China

- Novel MMG sensor: A pair of MMG sensor is design to capture single-site MMG.
- Features Fusion: To generate new features with multiple information.
- Optimized Algorithm: LSTM algorithm is optimized by proposed method

FrA1(4) 11:35-11:50

An Active Power Allocation Optimization Strategy for Wind Farm Frequency Response Considering Fatigue Loads

Yongheng Mao, Bingtuan Gao
School of Electrical Engineering, Southeast University, China

- In this paper, an active power allocation strategy for frequency regulation considering fatigue loads of wind farm is proposed.
- An optimization strategy model to coordinate active power variation of wind turbines is presented and solved by genetic algorithm.
- Simulation results verify that the proposed strategy can reduce the fatigue loads of wind farm remarkably while providing similar frequency response capability.

Active power control structure of wind farms

FrA1(5) 11:50-12:05

Cable Assembly based on Robot Manipulation and Control

Xiaobin Zhang, Congjian Li and Ning Xi
Department of IMSE, University of Hong Kong, Hong Kong S.A.R.

- A deep learning model is trained to predict a deformable cable's shape
- A sampling-based optimization algorithm is applied to generate robot actions in the planning process
- Another deep learning model is trained to generate robot actions in real time
- A dual-arm robot, ABB YuMi, is controlled to manipulate cables and put them into slots

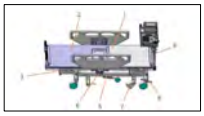
Robot manipulating the cables

FrA1(6) 12:05-12:20

Technology and Application of Medical Bidirectional Transport Robot

Guangwei Zhang
Cardiovascular Center, the First Hospital of Jilin University, China
Feng Jiang and Changshan Li
the Electronic information engineering college and the Artificial Intelligence college, Changchun University of Science and Technology, China

- Transport bed is a key equipment in the transport process in hospital.
- A transport robot which can seamlessly connect with different target beds with a bidirectional and large-stroke translation mechanism to transfer patients.
- Technological innovation can reduce the medical injury of patients and the labor intensity of medical staff in the transfer process.
- Combined with process re-engineering can reduce the personnel consumption and improve the transport efficiency, safety, universality.



1.backrest lifting and human body automatic anti-slip mechanism 2.bed translation mechanism 3.bed lifting mechanism 4.instrument equipment rack 5.integrated power supply 6.guardrail lifting mechanism 7.auxiliary support mechanism 8.brake system instrument equipment rack

Figure. General structure of transport robot

FrB2: Sensing and Recognition I

Session Chair: Qi Hu

Room : Songjiang, 2F, 14:00-15:30, Friday, July 29

FrB2(1) 13:30-13:45

Development of the Flexible Tactile Sensor for Safe Human-Robot Interaction

Kun Yang, Xinkai Xia, Huanzhou Ma and Fan Zhang
College of Information and Computer, TYUT, China

- The flexible tactile sensor is made by **sponge mixed with graphene** and it can convert the pressure of the contact surface into a resistance signal accurately.
- There is a nearly linear relationship between resistance value of sensing unit and applied force (0 - 5N).
- The flexible tactile can provide fast response for the robot arm when the human body touches the sensor.

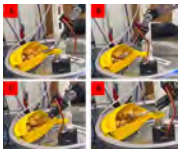
The human-robot interaction experiment.

FrB2(2) 13:45-14:00

A Vision-Based Target Localization System for the Meal Assistance Robot

Xueyi Zhao and Diansheng Chen
the School of Mechanical Engineering and Automation, Beihang University, China
Guo Xiang and Chenghang Pan
the School of Mechanical Engineering and Automation, Beihang University, China

- Different filtering methods are used for meals with different traits.
- Calculating food points with Gaussian distribution density.
- Estimating the weights of scooping points.
- Compute mouth pose using 2D to 3D matching.



FrB2(3) 14:00-14:15

Digital Twin-based Cement Rotary Kiln Simulation Training System

Zhuo Chao , Xiaohong Wang , Hongliang Yu and Shizeng Lu
Department of Automation and Electrical Engineering, University of Jinan, China

- Allows operators to learn directly the various operating conditions of the rotary kiln part of the cement and to train in actual operation.
- The digital twin principle shows in real time in a virtual screen the faults and the impact of the trainer's operation of the control system on the cement production line.
- Exercise the ability to troubleshoot in both the control room and the production site through the cooperation of the control room operator and the field operator.

3D model

FrB2(4) 14:15-14:30

Dynamic and flexible personal space model and parameter generation method for socially-aware robot navigation

Zhe Zhao, Xianyu Qi, Yufei Zhao and Xiangdong Yang
Beijing Institute of Mechanical Equipment, China
Ziwei Liao and Wei Wang
School of Mechanical Engineering and Automation, Beihang University, China

- A basic social cost model based on the mixture of four-Gaussian functions is established.
- A dynamic model based on the relative speed and robot mood regulation is established.
- The parameter generation method of the proposed model is introduced.

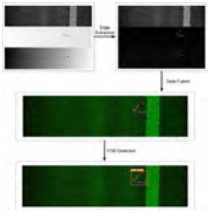
System overview

FrB2(5) 14:30-14:45

FOD Detection Using a Multi-channel Information Fusion Method

Yichao Cao, Guoliang Liu, Liujuan Zhu, Zhikun Zhu, Yide Zhang, Fei Lu and Guohui Tian
School of Control Science and Engineering, Shandong University, China
Guangyu Hui and Xiaobo Guo
Chinese Flight Test Establishment, China

- 3D laser line scanning camera is used to obtain three channel information.
- Sobel and Laplacian operation is used to extract edges of FOD.
- A multi-channel information fusion method is proposed for FOD detection.
- An improved YOLOv5 network is proposed to improve detection accuracy.



Flow chart of our method

FrB2(6) 14:45-15:00

Semantic Segmentation of FOD Using an Improved Deeplab V3+ Model

Zhikun Zhu, Guoliang Liu and Yichao Cao
School of Control Science and Engineering, Shandong University, China
Guangyu Hui, Xiaobo Guo
Chinese Flight Test Establishment,China

- Gray image and depth image are fused in the form of an attentional mechanism
- We added the attention mechanism to Deep lab V3+ network to form the CBAM-Deeplab V3+
- Focal Loss with dynamic weights was used as the loss function to iterate the model
- MIOU and MPA were used to evaluate the segmentation effect

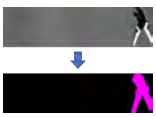


Image segmentation results

FrB3: Medical Robot I

Session Chair: Peng Su

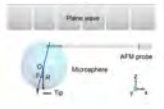
Room : Baishan 1, 2F, 14:00-15:30, Friday, July 29

FrB3(1) 13:30-13:45

Photonic hook through a microlens with a tip deposited at the bottom

Tianyao Zhang and Hao Luo
State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, Shenyang 110016, China;
Institutes for Robotics and Intelligent Manufacturing, Chinese Academy of Sciences, Shenyang 110016, China;
University of Chinese Academy of Sciences, Beijing 100049, China.
Haibo Yu, Xiaoduo Wang and Lianqing Liu
State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, Shenyang 110016, China; Institutes for Robotics Intelligent Manufacturing, Chinese Academy of Sciences, Shenyang 110016, China

- Presented a design for generating photon hooks
- A controllable PH can be generated on the backlight side
- Fabricated the microlens-AFM probe samples by FIB deposition tip technology



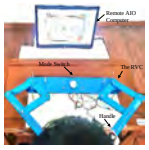
Schematic of the microns-AFM probe

FrB3(2) 13:45-14:00

A Novel Unpowered Mechanical Robot with Vibrotactile Feedback for Upper Limb Coordination Rehabilitation

Yuxuan Lin and Han Xu
Tongji Auckland Medical & Rehabilitation Equipment Research Center, Tongji Zhejiang College, China

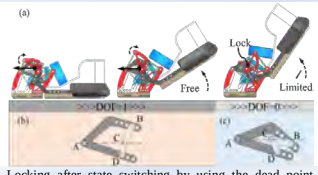
- Purely mechanical design for active (Coordination Mode) and passive (Mirror Mode) training of the affected limb
- Vibratactile feedback for enhanced biofeedback
- Vibrotactile feedback helps finishing the task with higher quality and efficiency
- Low cost, compact and lightweight design for home use



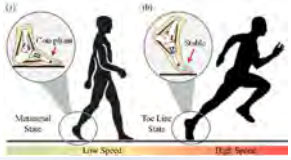
The REHA-VABRO-COORDINATOR (RVC)

FrB3(3) 14:00-14:15

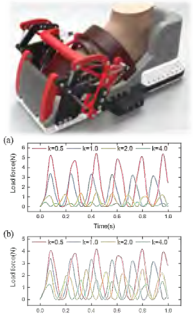
A Foot-based Wearable Assist Mechanism Based on Tensegrity Structure



Locking after state switching by using the dead point feature of the four-bar structure



The two states correspond to the walking state and the running state respectively



The self-recovery characteristics of toe joints can be improved by changing the stiffness coefficient and arrangement of spring in tensegrity structure.

FrB3(4) 14:15-14:30

Research on exoskeleton structure design of hand function rehabilitation robot

Kexin Zuo, Ben Wang, and Yangwei Wang, Member, IEEE

Northeast Forestry University, China

In order to develop a hand function rehabilitation device that is convenient for patients to wear and operate and has a simple structure, the physiological structure of fingers was analyzed. On the basis of the form and principle of finger movement, this paper proposes a design scheme for the exoskeleton structure of the hand function rehabilitation software with shape memory alloy (SMA) wire as the driver, establishes the driving model, and conducts a kinematic analysis of the simplified model of the finger, it is calculated that the length of alloy wire required for a normal finger to complete a limit buckling action is 600mm. A hand function rehabilitation robot prototype was developed and a test platform was built. A finger bending test and fingertip force test under different voltages were carried out to verify the performance of the hand function rehabilitation soft exoskeleton robot.

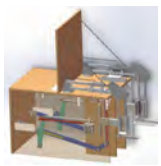
FrB3(5) 14:30-14:45

Research on lower limb rehabilitation training device based on gravity balance

Zhen zhang, Taisheng Zhang, Yanpeng Kan, Manman Xu

Anhui Polytechnic University,China

- lower limb rehabilitation training device for MMT-2 patients
- Gravity balance for the calf and thigh
- Mechanical structure designons and Kinematic analysis



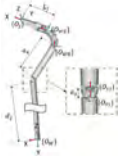
3D diagram of the device

FrB3(6) 14:45-15:00

Kinematics Modeling and Simulation of a Flexible Surgical Robotic Instrument with a Multi-joint Wrist

Xingshuai Li and Qinjian Zhang
Beijing Information Science and Technology, China
Haiyuan Li*, Baoguo Liu, Qingqing He
Beijing University of Posts and Telecommunications, China
Peking University Cancer Hospital & Institute, China
The 960th Hospital of the PLA Joint Logistics Support Force, China

- The wrist of robot is stacked by several rigid articulated joints to make a continuum structure.
- The wrist joint use the Constant Curvature model and other joints use the modified DH parameters to model the forward kinematics.
- The sequence quadratic optimization(SQP) numerical method is used to solve the inverse kinematics, the maximum error of position and orientation is 9.47×10^{-2} mm and 8.82×10^{-2} deg, respectively.



Definition of coordinate system for surgical robot

FrB4: Optimization and Control I

Session Chair: Yongliang Yang

Room : Baishan 2, 2F, 14:00-15:30, Friday, July 29

FrB4(1) 13:30-13:45

The improved approach for calculating residual error rates in SIS communication

Xiufang Zhou, Aidong Xu , Bingjun Yan and Yue Sun
Shenyang Institute of Automation, Chinese Academy of Sciences, China

- The residual error rates of full and partial redundancy models are different.
- The effects of time expectations and different verification approaches for connection identification is shown.
- A hypergeometric distribution approach is used when the partial message redundancy mode is considered.

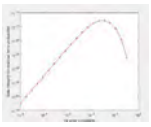


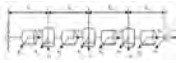
Figure caption is optional, use Arial 18pt

FrB4(2) 13:45-14:00

A Dimensional Parameter Optimization Method of Manipulator to Improve Manipulability

Zhi Li
School of General Engineering, Beihang University, China
Haoqin Gong*, Yuanhai Huang and Diansheng Chen
School of Mechanical Engineering and Automation, Beihang University, China

- The configuration of a seven degree-of-freedom manipulator is analyzed through decoupling
- Theoretical analysis is conducted to evaluate the dexterous workspace volume to improve the manipulability
- The optimization result is obtained and also verified by simulation



Configuration of the seven degree-of-freedom manipulator

FrB4(3) 14:00-14:15

A Novel Method to Solve the Inverse Kinematics for Continuum Robots Accelerated by PID Theory

Yihua Fang, Samuel Hill, Weiming Ba and Xin Dong
Department of Mechanical, Materials and Manufacturing Engineering, University of Nottingham, United Kingdom

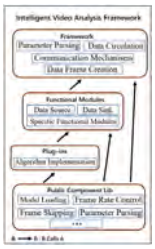
- The proposed method uses PID theory to reduce computing time of the Beta-step Inverse Kinematics.
- Within the computing process, the value of $\Delta\beta$ dynamically changes with errors.
- This method is programmed in MATLAB and tested in a target working area.
- This method is proved to have less computing time and iterations than the original method.

FrB4(4) 14:15-14:30

Design and Implementation of a Highly Compatible Intelligent Video Analysis Framework

Lanfang Dong, Yongsheng Chen and Yuhang Zhang
School of Computer Science and Technology,
University of Science and Technology of China

- This paper presents an intelligent video analysis framework for multiple scenarios
- The framework is hierarchical, with clear data flow and strong compatibility
- The framework improves video processing speed using techniques such as pipelining, heterogeneous programming
- Experiments on eye-movement and expression recognition using the framework demonstrate the superiority of the framework

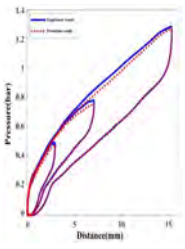


FrB4(5) 14:30-14:45

A Comprehensive Dynamic Hysteresis Inverse Compensator for Pneumatic Artificial Muscles

Ying Zhang*, Qiang Cheng, Haoze Gao
Mechanical Engineering & Automation, Northeastern University, Shenyang 110819, China.
Wenlin Chen
School of Resources and Civil Engineering, Northeastern University, Shenyang 110819, China

- The PAM hysteresis performance is affected by the amplitude and the frequency of the input signal and applied load.
- A hysteresis inverse compensator is proposed to describe the dynamic inverse hysteresis behavior of PAM.
- Open-loop hysteresis compensation control experiments on PAM are conducted.



FrB4(6) 14:45-15:00

A Neural-Driven Musculoskeletal Model for Continuous Estimation of Hand and Wrist Movements

Shizhuo Yue, Jianmin Li, and Lizhi Pan
School of Mechanical Engineering,
Tianjin University, China

- Neural-driven musculoskeletal model
- Estimation of hand and wrist movements
- Robust continuous control

FrPo4: Poster Session 4

Session Chair: Li Wen

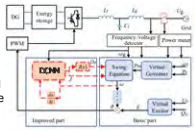
Room : Foyer, 1F, 15:30-16:00, Friday, July 29

FrPo4(1) 15:00-15:30

DCNN-based virtual synchronous generator control to improve frequency stability of PV-ESS station

Wei Zeng and Junjie Xiong
State Grid Jiangxi Electric Power Research Institute, Nanchang, Jiangxi
Zongqiang Qi and Xiaobo Dou
School of Electrical Engineering, Southeast University, Nanjing, Jiangsu

- The virtual synchronous generator (VSG) based on the energy storage system is proposed to compensate the loss of inertia and damping of the power grid. Due to the introduction of inertia, VSG is more prone to power oscillation. In this article, the nonlinear relationship between inertia and angular velocity is analyzed, and adaptive neural network (DCNN) control is applied to VSG. Based on this concept, an adaptive control strategy is proposed. First, the DCNN that enjoys a simple algorithm, strong ability of learning, and fast learning rate is used to adjust virtual inertia adaptively. This strategy not only improves response but also reduces frequency overshoot in tracking the steady-state frequency. And then, based on the fixed damping ratio, the damping coefficient is tuned adaptively with the change of the inertia to further suppress power oscillation. The proposed strategy is supported by simulation results, which show that the strategy has good performance in damping of oscillation.



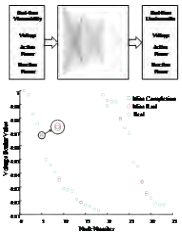
Overall control structure of the VSG with the DCNN controller

FrPo4(2) 15:00-15:30

Data processing technology of distribution station area combined with convolutional neural network

Kexin Zhang, Xiaobo Dou, Hang Yu and Yongming Hu
School of Electrical Engineering, Southeast University, China

- Now the station area has more problems in data collection and storage than the Central Asian side. Aiming at the problems of abnormal sampling period, abnormal sampling reference time, data noise, and missing data in the data of the station area, this paper proposes a data processing method combining convolutional neural network and mathematical methods to solve these problems in the station area, and constructs a station The accurate time series of regional data was obtained, and the feasibility of the method was verified by simulation.



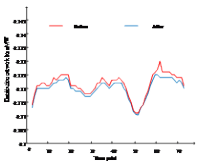
Voltage Completion Process and Effect

FrPo4(3) 15:00-15:30

Photovoltaic and energy storage control of partially observable distribution network based on deep reinforcement learning

Qiangsheng Bu, Pengpeng Lv and Fei Luo
Economic Research Institution, State Grid Jiangsu Electric Power Co, China
Kexin Zhang and Xiaobo Dou
School of Electrical Engineering, Southeast University, China

- Volatility and uncertainty brought by distributed power sources may lead to the over-limit of the distribution network voltage and the increase of network losses, photovoltaic and energy storage are selected as the control objects. In this paper, a photovoltaic energy storage linkage control technology based on deep reinforcement learning is designed, and an example is used to verify the feasibility and effectiveness of the method proposed in this paper.



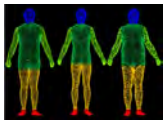
Network loss reduction effect diagram

FrPo4(4) 15:00-15:30

Research on Human Features Semantic Segmentation Based on Laser Point Cloud

Tianyi Ma, Bokai Xuan, Jian Li, Yuexuan Xu, Minghe Liu, Qingsong Ding, Hao Sun*
School of Artificial Intelligence and Data Science, Hebei University of Technology, China
Jian Li
School of Automation, Beijing University of Posts and Telecommunications, China
Jianwen Wang
Shun Kangda Medical Technology Company Limited , China

- Semantic segmentation of human body in bathing environment
- Combine the spatial feature extraction module and the channel attention module
- Overcome the effects of water mist on human modeling



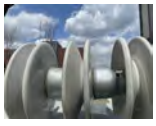
Human Features Semantic Segmentation

FrPo4(5) 15:00-15:30

Improved YOLOv5-based Method for Recognition of Insulator String Pins

Jingbo Du
College of Automation and Electrical Engineering, Shenyang Ligong University, China
Yong Jiang
State Key Laboratory of Robotics Shenyang Institute of Automation, China

- I. Foreword
- II. YOLOv5 Algorithm principle
- III. YOLOv5 Improvements
- IV. Experimental



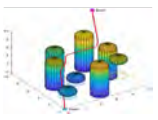
Recognition results

FrPo4(6) 15:00-15:30

Three Dimensional Path Planning of Snake-Arm Robot Based on Improved Ant Colony Algorithm

Chen Xu
Shenyang Institute of Automation Chinese Academy of Sciences, China
Jiang Yong
Shenyang Institute of Automation Chinese Academy of Sciences, China

- Improved ant colony algorithm is used for path planning
- Ant colony algorithm is combined with artificial potential field method
- Path smoothing meets the movement requirements of Snake-Arm



FrPo4: Poster Session 4 (cont.)

Session Chair: Li Wen

Room : Foyer, 1F, 15:30-16:00, Friday, July 29

FrPo4_2(7) 15:00-15:30

Economic Analysis of Waste Heat Utilization in Data Center under Different Business Models

Wei Fang, Jiaqi Li, Chenglei Sun , Fangyuan Pan
State Grid (Beijing) Integrated Energy Planning and Design Institute Co., Ltd, China
Tianheng Chen, Yi Ding
State Grid Tianjin Electric Power Company, China

- The average annual net profit of the investor under BT mode is the highest.
- Under BOT mode, the profit of data center operators is stable .
- Operating lease mode are suitable for data center projects with lack of construction funds.

FrPo4_2(8) 15:00-15:30

Research on OpenCV-based method for monitoring the amount of intestinal coating accumulation

Qingsong Ding Yuexuan Xu, Tianyi Ma, Minghe Liu, Hao Sun
School of Artificial Intelligence and Data Science, Hebei University of Technology,Tianjin
Qiang Li
Inner Mongolia Biological Co, Ulaanchab

Sausage coating production line

image processing

color space

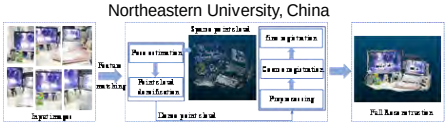
stacking volume monitoring

Enteric coating stacking volume testing system

FrPo4_2(9) 15:00-15:30

A 3D Reconstruction Technology of Indoor Scene based on Image Sequence

Songna Zhang, Tong Jia, Wenhao Li and Xiaojun Sun
College of Information Science and Engineering,
Northeastern University, China



The overall workflow of this paper.

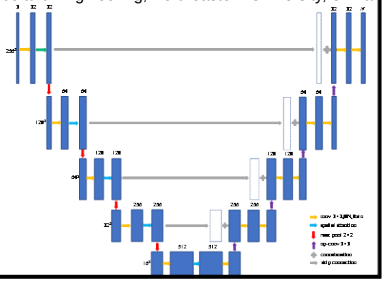
- Firstly, this paper adopts a uniform extraction of ORB features method based on octree and a feature matching method based on colour and descriptor distance information.
- Secondly, this paper adopts a point cloud fine-registration method based on a double threshold constraint.
- Finally, experimental analysis is carried out in a real indoor scene to verify the effectiveness of the proposed algorithm in reconstruction efficiency and accuracy

FrPo4_2(10) 15:00-15:30

SA-Unet: A Phase Unwrapping method based on DCNN

Feng Liang, Tong Jia and Zhikang Zeng
College of Information Science and Engineering, Northeastern University, China

- Phase unwraping
- Attention module
- Deep learning

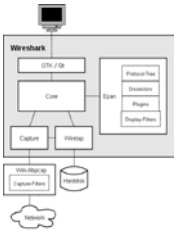


FrPo4_2(11) 15:00-15:30

Design of a FF HSE Message Analysis Tool Based on Wireshark

Shuwei Ding, Lin He, Yuanbei Gu, Weihua Bao
Shanghai Automation Instrumentation Co., Ltd., China

- Study the message specification of FF HSE protocol
- Use LUA language to develop the Wireshark parser plug-in
- Provide the design of message analysis tool
- A new idea for detecting fieldbus faults

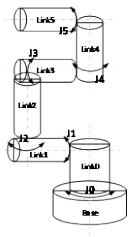


FrPo4_2(12) 15:00-15:30

Posture Estimation of Articulated Robot Based on Multi-cylinder Segmentation

Kuicheng Chen and Hongtai Cheng
Department Name, Northeastern University, China

- This paper proposes a posture estimation method for multi-cylinder articulated robot.
- The proposed method consists of three parts: cylinder segmentation, cylinder fitting, and joint angles calculation.
- The cylindrical segmentation algorithm uses curvature calculation, which is simple and efficient.
- The proposed method has high robustness and small error.



FrPo4: Poster Session 4 (cont.)

Session Chair: Li Wen

Room : Foyer, 1F, 15:30-16:00, Friday, July 29

FrPo4_3(13) 15:00-15:30

Global Semantic Information-based Text Detection and Recognition Networker

Jiazheng Tian and Qi Hu
School of Electronic And Information Engineering, Changchun University of Science and Technology, China

- The overall framework is composed of detection module and identification module
- The detection module adopts the full convolutional network as the text detector
- Recognition module introduces Transformer to enhance semantic information
- Introduce momentum stochastic gradient descent method based on fractional order to improve the identification accuracy

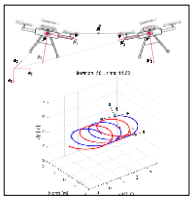
Overall framework diagram

FrPo4_3(14) 15:00-15:30

Trajectory Planning of Quadrotors Flight like Binary Star

Xuan Zhang ,Guangyu Zhang, Liying Yang, Yanchun Chang, Zhaoxiong Huang, Miao Sun and Yuqing He
the State Key Laboratory of Robotics, University of Chinese Academy of Sciences, China

- Two quadrotors flight like binary star steadily at high speed
- Take dynamic constraints into account in trajectory planning of quadrotor
- Geometric controller is used to ensure the exactly tracking of the planed trajectory
- The simulation results show that proposed trajectory planning method was feasible



Quadrotors system and the trajectory tracking results

FrPo4_3(15) 15:00-15:30

A TB-CSP Motor Imagery EEG Recognition Method for Neural-controlled Manipulator System

Wei Mu and Pengchao Wang
Academy for Engineering & Technology, Fudan University, Shanghai
Xiaoyang Kang
Academy for Engineering & Technology, Fudan University, Shanghai

- Calculate the average Bhattacharyya Distance of EEG in different time-frequency windows
- The calculated features are sorted and input into SVM and LDA for classification
- Generate control signals from EEG classification results and apply them to manipulator control
- The accuracy of the proposed method on Dataset A and Dataset B is 82.6% and 79.48% respectively.

Framework of the manipulator control system.

FrPo4_3(16) 15:00-15:30

Motion Analysis and Simulation Verification of Novel Quadruped Robot

Zhongjin Ju, Ke Wei, Yundou Xu, Jiantao Yao and Yongsheng Zhao
Parallel Robot and Mechatronic System Laboratory, Yanshan University, China

- A novel mechanical structure of a quadruped robot is designed, and the DOFs of movement of the proposed robot are analyzed
- The influence of different joint configurations on the performance of a quadruped robot is analyzed by the screw theory
- Trot gait and crawl gait are designed for 4-SPRR quadruped robot, and the influence of different crawling gait on stability is briefly described

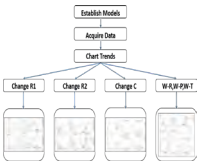
A kind of quadruped robot with novel structure is proposed, which is called 4-SPRR quadruped robot.

FrPo4_3(17) 15:00-15:30

Electrochemical impedance behavior of implantable neural interface following the change of equivalent circuit element

Jing Zhang, Lusheng Liu, Aiping Wang, Junkongshuai Wang, Tao Fang, Lan Niu, Jianxiong Bin, Pengchao Wang, Wei Mu, Jie Jia, Lihua Zhang, and Xiaoyang Kang
Institute of AI and Robotics, Fudan University, China

- Establish two equivalent circuits: equivalent circuit model of charge transfer process and that of charge transfer and diffusion process.
- Obtain electrochemical impedance data for individual parameter changes of equivalent circuit elements using the control variable method and analysis the trends.
- provide a theoretical method for developing customized implantable neural interface with specific electrochemical impedance.



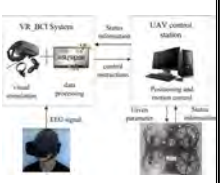
Framework of the experiment.

FrPo4_3(18) 15:00-15:30

Route Control of Four-rotor UAV based on Brain-Computer interface in Virtual Reality

Lan Niu, Jianxiong Bin, Junkongshuai Wang, Gege Zhan, Haifeng Jiang, Zhiyang Dong, Lihua Zhang, and Xiaoyang Kang
Institute of AI and Robotics, Fudan University, China

- Present an online system combined BCI and VR system to steer the four-rotor UAV.
- Evaluate the effect of dynamic 3D vision-evoked modules on the performance of the system.
- Propose an effective solution to overcome the effect of dynamic movement of 3D paradigm.
- The accuracy of the proposed system is 89.4% and ITRs is 26.862 bits/m.



General design of the system

FrPo4: Poster Session 4 (cont.)

Session Chair: Li Wen

Room : Foyer, 1F, 15:30-16:00, Friday, July 29

FrPo4_4(19) 15:00-15:30

Research on Haptic Feedback Control System of Bionic Pulse Diagnosis Equipment

Ji Zhongzhi, Wang Yang, Huang Yulin, Zhu Xing, Wang Fanyu, Luo Jingjing*
Ji Hua Laboratory, Foshan, China

- This paper built the pre-pressure control system for pulse diagnosis equipment of Traditional Chinese Medicine
- The dynamic model of "Guan" organization was designed based on NARX neural network
- The adaptive RBF neural network controller was proposed for this pre-pressure control system
- Both the simulation and laboratory experiments showed: this control system could achieve design control precision

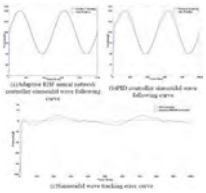


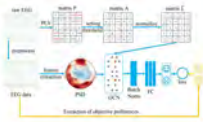
Figure1. Sinusoidal wave tracking curve

FrPo4_4(20) 15:00-15:30

Exploring Humanoid Robot Face Preference Using Brain Functional Connectivity and Graph Neural Network

Pengchao Wang, Wei Mu, Gege Zhan, Aiping Wang, Zuoting Song, Tao Fang, Xueze Zhang, Junkongshuai Wang, Lan Niu, Jianxiong Bin, Lihua Zhang, Jie Jia, and Xiaoyang Kang
Institute of AI and Robotics, Fudan University, China

- Analysis of humanoid robot face preferences using brain functional connectivity .
- Using the matrix obtained based on brain functional connectivity measurements as a GNN connectivity matrix.
- The average accuracy of our proposed method reached 73.47%.
- There are differences in the functional connectivity of preferred and non-preferred brains.



The framework of face preference detection in humanoid robots is based on EEG signals.

FrPo4_4(21) 15:00-15:30

A Remotely Driven Finger Rehabilitation Robot for Passive and Active Rehabilitation

Hongbo Wang
Academy for Engineering & Technology, Fudan University, China
Jiazheng Du and Yongshun Zhang
Key Laboratory of Parallel Robot, Yanshan University, China

- A robot with 9 DoF for the rehabilitation of five fingers in human hands
- The drive distal arrangement reduces the weight of the system and the wear burden
- The two flexible components, alloy wire and spring, improves the adaptability and fault tolerance

Finger Rehabilitation Robot.

FrPo4_4(22) 15:00-15:30

Research on Variable Workspace of Continuum Robot for Organ Protection and Multi-arm Cooperation

Fuhao Wang, Hongbo Wang, Jingjing Luo, Xiaoyang Kang, Xueze Zhang, Jiawei Wang, Qiqi Pan
Academy for Engineering & Technology, Fudan Universit, China

- Surgical continuum robot could damage organs or collide
- Variable workspace: In the inherent workspace, the intersections caused by other factors are eliminated.
- The variable workspace is dynamic, organ protection can be achieved at any time.
- Variable workspace prevents collisions in Multi-arm cooperation

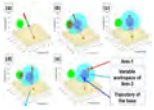


Fig. Organ protection and multi-arm cooperation

FrPo4_4(23) 15:00-15:30

A three-finger dexterous hand with suction cups integrated on fingertips

Yuanbo Liu , Wenjie Lu, Diansheng Chen and Weidong Guo
Robotics Institute, Beihang University, China

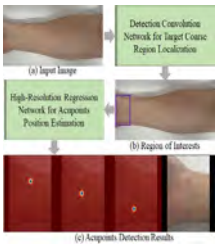
- Three-finger dexterous hand with a human-like layout
- Fingertips with integrated suction cup can touch and adsorb objects
- Experiments show that the new design can easily implement complex grasping tasks

FrPo4_4(24) 15:00-15:30

An Acupoint Detection Approach for Robotic Upper Limb Acupuncture Therapy

Bin Cai[1,2], Peiyang Sun[3], Meng Li[3], Erkang Cheng[1], Zhiyong Sun[1], Bo Song[1*]
1 Institute of Intelligent Machines, HFIPS, Chinese Academy of Sciences; 2 Universityof Science and Technology of China;
3 The Second Affiliated Hospital of Anhui University of Chinese Medicine

- In this paper, we propose a coarse to refine neural network model to detect and locate the acupoints on the upper limb for robotic acupuncture therapy. Specifically, a target coarse region is obtained by model each region as the center point of its bounding box in the coarse step, the target coarse region is used to define region of interests (ROI) for refine step. Then, the acupoints are located by transforming the acupoints position estimation problem to estimating the heatmaps of each acupoints using the cropped ROI from the original image.
- Our acupoints detection results are compared to the groundtruth ones which are annotated by experienced acupuncturist from the Second Affiliated Hospital of Anhui University of Chinese Medicine. Experiment results demonstrate that our coarse-to-refine method can effectively detect the acupoints with high accuracy.



FrPo4: Poster Session 4 (cont.)

Session Chair: Li Wen

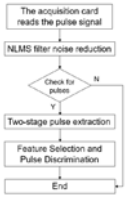
Room : Foyer, 1F, 15:30-16:00, Friday, July 29

FrPo4_5(25) 15:00-15:30

Remainder particles detection method for spaceborne electronic equipment

Junyu Shi and Zhishuai Jiang and Yuliang Zhao
Control engineering, Northeastern Universityc
Zengshuai Qiu
DFH Satellite Co., Ltd. Beijing, China

- Using NLMS filtering method to filter out mechanical noise and DC offset
- Two-level threshold extraction algorithm based on short-time energy and short-time zero-crossing rate to extract pulses
- Chi-square test determines the features with the highest correlation with remainder particles
- Discrimination of remainder particles pulses with selected features



Remainder particles detection flow chart

FrPo4_5(26) 15:00-15:30

The effect of tailored-made home-based exercise program on the training adherence of old patients underwent total hip and knee arthroplasty: A Randomized Controlled Pilot Study

Rongke Lv, Kangping Song, Peihui Wu, Yangfan Xu
Yangyang Lin and Yuling Wang

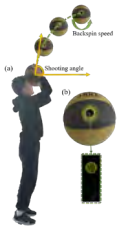
- tailored-made home-based exercise program
- old patients underwent total hip and knee .

FrPo4_5(27) 15:00-15:30

Regression prediction of key action indicators of shooting based on machine learning method

Xiaoai Wang and Jian Li and Shengfan Wang and Meilun Jiang and Yuliang Zhao
Control engineering, Northeastern University, China
Wenyan Zhang
Beijing Technology and Business University, China

- In order to describe the shooting action in detail , we selecting four key detailed action indicators, including shooting angle, backspin speed, elbow abduction angle at shot and maximum elbow abduction angle.
- Image processing and eRock intelligent basketball are used to obtain the real values of four key action data.
- Five machine learning methods are used to perform regression prediction on four key action indicators.



The Shooting process image

FrC2: Sensing and Recognition II

Session Chair: Qi Hu

Room : Songjiang, 2F, 16:30-17:30, Friday, July 29

FrC2(1) 15:30-15:45

Microarray Image Segmentation Based on Level Set and Regridding

MD Shahriar Haque, Nishith Ranjan Biswas, Mubeen Afzal, Daria Hussain Antora and Lu Bibo
Computer Science and Technology, Henan Polytechnic University, China

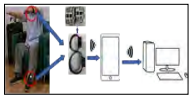
- Importance of microarray images
- Difficulties of microarray segementation
- Some conventional method for microarray segmentation
- A suitable method for the segmentation of microarray image

FrC2(2) 15:45-16:00

A Parkinson's Bradykinesia Recognition System Based on Deep Learning Method

Lina Tong, Daisong Liu and Mingjia Zhang
School of Mechanical Electronic & Information Engineering, Chinese University of Mining and Technology-Beijing, China
Liang Peng
State Key Laboratory of Management and Control for Complex Systems, Institute of Automation, China Academy of Science, China

- A wristband and anklet was designed to identify Parkinson's bradykinesia.
- Subjects and data collection were from Beijing Union Medical College Hospital.
- Long-short-term memory network was used to identify Parkinson's bradykinesia.
- The recognition rate of bradykinesia symptoms in Parkinson's patients was 98.6%



FrC2(3) 16:00-16:15

A POMDP-based Robot-Human Trust Model for Human-Robot Collaboration

Pallavi Tilloo, Jesse Parron, Omar Obidat, Michelle Zhu, and Weitian Wang*
Department of Computer Science, Montclair State University, Montclair, USA

- Trust is a cognitive ability that can be said to be dependent on behavioral consistency.
- A POMDP-based computational robot-human trust model is proposed for hand-over tasks in human-robot collaborative contexts.
- The robot's trust in its human partner is evaluated based on the human behavior estimate and object detection during the hand-over task.
- We verify the proposed approach in real-world human-robot collaborative tasks.

Human-robot collaboration using the proposed trust model.

FrC2(4) 16:15-16:30

Body Alcohol Level Detection Based on Measurements of Human Balancing

Jia-Ming Chen, Song Wang , Yu-qing Tian and Wen-bo Yuan
Department of Industrial and Manufacturing Systems Engineering, The University of Hong Kong, China
Ning XI , Fellow, IEEE
Department of Industrial and Manufacturing Systems Engineering, The University of Hong Kong, China

- Developed an optics-based new sensor capable of assessing human balance
- Calculated center of pressure (CoP) and center of gravity (CoG) before and after alcohol consumption
- Analyzed the correlations between BAC and the cross-entropy of center of pressure (CoP) and center of gravity (CoG)

FrC2(5) 16:30-16:45

Towards Real-Time Synchronization of mBot's Motion with Musical Songs

Wayne Jason LI
St. Stephen's College, Stanley, Hong Kong SAR, China
Yuqing TIAN, Chun KWOK and Ning XI
Dept. of Industrial and Manufacturing Systems Engineering, The University of Hong Kong, Hong Kong SAR, China

- A computer code was developed to control the movements and LED colors of an mBot based on real-time recognition of musical sound amplitude and frequency.
- Analyze the impact of noise and embedded computing performance on experimental results.

Experimental results of the mBot responding to different musical sources.

FrC2(6) 16:45-17:00

Scheduling Optimization of Automatic Biochemical Analyzer based on Particle Swarm Optimization

Mingyue Zhao, Mingxing Lin and Wenjing Fan
School of Mechanical Engineering, Shandong University, China
Qinghua Xie and Bo Wang
JINAN BIOBASE BIOTECH CO.,LTD, China

Automatic biochemical immune analyzer is often used in clinical examination and diagnosis, and its efficiency is very important. At present, most automatic biochemical analyzers use fixed period algorithm for scheduling, which has long detection time, low efficiency and intermittency. In this paper, a scheduling method based on particle swarm optimization (PSO) algorithm is proposed. The algorithm adopts sequence coding method, and approximates the scheduling problem of automatic biochemical analyzer to ATSP, and establishes ATSP model suitable for the scheduling problem of fully automatic biochemical analyzer, so as to optimize the scheduling of automatic biochemical analyzer.

FrC3: Medical Robot II

Session Chair: Haiyuan Li

Room : Baishan 1, 2F, 16:30-17:30, Friday, July 29

FrC3(1) 15:30-15:45

Design and Development of Unmanned Combat Game Platform

Lina Hao, Zhe Li, Shuai Wang and Chenling Hao
School of Mechanical Engineering and Automation,
Northeastern University, China

- A unmanned combat deduction platform that enables secondary design of the scene
- The platform is effective to describe scene information
- The platform supports our proposed PPO-based decision-making algorithm

Combat process

FrC3(2) 15:45-16:00

•Design and kinematics analysis of tibial orthopedic external fixation robot based on bone external fixation technology

Yuliang Lai, Lin Liu, Shihui Xie, and Peng Su*
School of Mechanical and Electrical Engineering, Beijing Information Science and Technology University, Beijing, China;
Li Zhang
Affiliated Rehabilitation Hospital of National Rehabilitation Accessories Research Center. Beijing, China
Jian Li
National Research Center for Rehabilitation Aids and Key Laboratory of Rehabilitation Aids Technology and System of Ministry of Civil Affairs. Beijing, China;

- The configuration of the external fixation robot for tibial orthopedics
- Robotic design of bone external fixation
- Bone external fixation robot kinematics analysis

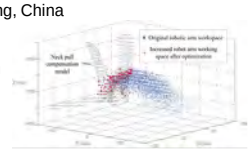
Schematic diagram of motion branch chain of external bone fixation robot

FrC3(3) 16:00-16:15

Modeling and Validation of Safe Space in the Operating Area of Minimally Invasive Thyroid Surgery Robot

Chao Yue, Peng Su*, Jiang Li, Qinran Zhang, and Qinjian Zhang
School of Mechanical and Electrical Engineering, Beijing Information Science and Technology University, Beijing, China
Baoguo Liu
Department of Head & Neck Surgery, Peking University Cancer Hospital & Institute, Beijing, China

- Modeling of the intracavity flexible arm
- Modeling of the surgical workspace
- Modeling of neck pull compensation
- Simulation verification and analysis



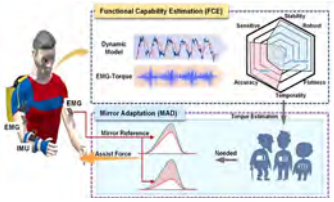
Neck pull compensation model and flexible arm workspace

FrC3(4) 16:15-16:30

Human-in-the-loop Optimization for Adaptive Assist-as-Needed Rehabilitation

Ning Li, Yang Yang, Tie Yang, Wenyuan Chen, Peng Yu, Wenxue Wang, Ning Xi, and Lianqing Liu
Shenyang Institute of Automation, Chinese Academy of Sciences (CAS), China,
Yihan Wang
School of Electrical and Electronics Engineering, Nanyang Technological University, Singapore

- A Mirror Adaptive Assist-As-Needed (MAAN) scheme is proposed to encourage subjects to avoid the slack of the.
- The MAAN strategy can generate assistance for the patients to correct abnormal muscle activation patterns and promote active participation.



The human-in-loop MAAN strategy framework

FrC3(5) 16:30-16:45

A Robotic Platform for Digitalized Pulse Information Collection

Zhu Xing, Ji Zhongzhi, Wang Fanyu, Zhou Peng
Institute of AI and Robotics, Academy for Engineering and Technology, Fudan University, P.R.China
Luo Jingjing
Engineering Research Center for Intelligent Robotics, Jihua Laboratory, Guangdong, P.R.China

- The mechanical can quickly apply pressure and implement real-time force-controlled for pulse collection
- Pulsing localization model can be improved by enriching training set from different subjects
- Pulse taking force control accuracy is within ±2.5 gf, from 50gf to 200gf
- Automatic positioning success rate is 93%, data collection effectiveness is 97% on the robot

Figure caption is optional, use Arial 18pt

FrC3(6) 16:45-17:00

Mental Health Problems of Older Adults During the COVID-19 Pandemic and Healthcare Robot-Mediated Therapy

Xisheng Lin, Tianyu Jiang, Na Wang, Shengjie Li, Wei Chen, Huiyan An, Qian Ren, Tao Xie and Changshui Weng
Department of Rehabilitation Medicine, The Second Medical Center and National Clinical Research Center for Geriatric Diseases, Chinese PLA General Hospital, No.28 Fuxing Road Beijing 100853, China.

- The outbreak of COVID-19 had profound effects on the mental health of older adults.
- Healthcare robots played a vital role in the psychosocial care of older adults.
- Social robots can provide strong support for the mental health of older adults during the COVID-19 pandemic.

Social robots: Providing social interaction and monitoring in a long term care environment.

FrC3: Medical Robot II (cont.)

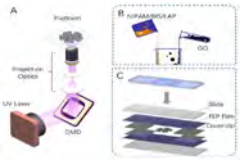
Session Chair: Haiyuan Li

Room : Baishan 1, 2F, 16:30-17:30, Friday, July 29

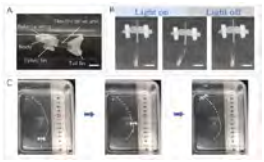
FrC3_2(7) 17:00-17:15

A light-driven swimming micro-fish based on photo-responsive hydrogel

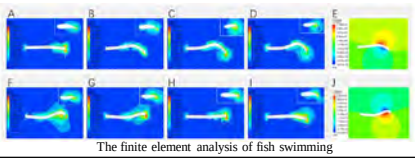
Zhen Wang, Xiaowen Wang and Wenguang Yang
School of Electromechanical and Automotive Engineering, Yantai University,



Schematic diagram of the digital micromirror-based light curing system.



Light-controlled swimming trajectory of the micro-fish



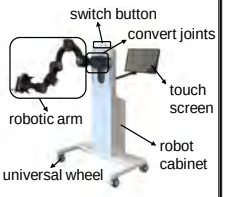
The finite element analysis of fish swimming

FrC3_2(8) 17:15-17:30

Human-Computer Interaction Technology for Upper Limb Rehabilitation Based on Gesture Recognition Control

Xuedong Zhu ,Mingxing Lin, Yubo Liu, Wenjing Fan and Chaoguo Shi
School of Mechanical Engineering,Shandong University, China

- A two-limb universal upper limb rehabilitation robot with 7 degrees of freedom is designed to satisfy the use of left and right limbs
- The non-contact human-computer interaction gesture recognition technology based on Kinect is studied to respectively realize the rehabilitation of both right and left hands
- A human-computer interaction experimental platform based on gesture recognition is built to test and realize a variety of rehabilitation modes for left and right limb training



FrC4: Optimization and Control II

Session Chair: Yongliang Yang

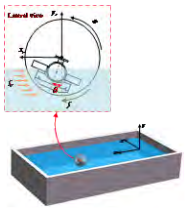
Room : Baishan 2, 2F, 16:30-17:30, Friday, July 29

FrC4(1) 15:30-15:45

Fuzzy Control of a Two-wheel Driven Spherical Robot Moving on the Surface of Water

Anqing Hu, Bingtuan Gao and Huan Wang
College of Electrical Engineering, Southeast University, China

- In this paper, the dynamic model of the spherical robot moving on the surface of water is established and its equilibrium point is analyzed.
- A fuzzy controller designed with a single input and a single output is proposed to stabilize and position control of the system.
- Simulation and experimental results have verified the efficacy of the proposed control method.

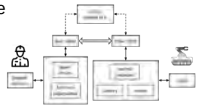


FrC4(2) 15:45-16:00

Operations Using Network Address Translation (NAT) Traversal

Xinyu Liu, Yuxuan Xue and Ning Xi
Faculty of Engineering, The University of Hong Kong, China
Chun Ho So
Department of Biomedical Engineering, City University of Hong Kong, China
Burak Kizilkaya and Guodong Zhao
School of Engineering, University of Glasgow, UK

- Delays caused by the Internet's complexity are critical issues for remote control robots
- We apply NAT traversal to the robotic teleoperation system
- Using NAT traversal for data transmission can effectively reduce the delay
- The impact of using the remote control on the operator is minimized.



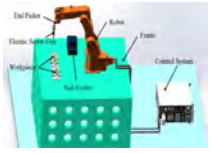
The Robotic teleoperation system using NAT traversal

FrC4(3) 16:00-16:15

Fastening Operation Analysis and Optimization with Desktop

Li Cheng*, Xin Cong, Chaohai Xu, Ze Huang
College of Mechanical Engineering, Shenyang University, ShenYang, China.

- Propose the **converting human** tightening assembly action into robot assembly action method.
- Simulate and optimize the trajectory and find the **comfortable position**.
- Optimize the **evaluation index** of production efficiency, from the joint angle, angular acceleration and torque.
- Use the experiment to find the **space trajectory position** that is more suitable.



The robotic fastening system

FrC4(4) 16:15-16:30

Adaptive backstepping sliding mode control of lower limb exoskeleton robot based on combined double power reaching law

Wen-Xin Xu, Guang-Zhong Cao, Yue-Peng Zhang, Jiang-Cheng Chen, Dong-Po Tan and Zi-Qin Ling
FirstName LastName
Guangdong Key Laboratory of Electromagnetic Control and Intelligent Robots, Shenzhen University, China

- The block diagram of the control system is in Fig. 1.
- the CDPRL is used to weaken the chattering and improve the convergence speed
- The experiment results show the trajectory tracking accuracy and anti-interference ability are improved

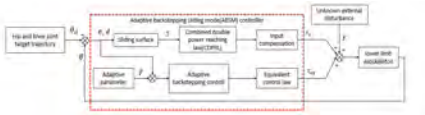


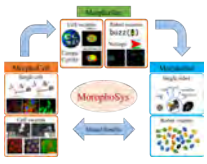
Figure 1. Block diagram of the control system

FrC4(5) 16:30-16:45

MorphoSys Bridges Morphogenesis in Swarms of Cells and Robots

Yongliang Yang, Mengyun Pan, Long Cui and Lianqing Liu
State key laboratory of robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, China

- MorphoSys: a R&D platform for swarm robotics integrating cell swarms and robot swarms
- The platform includes MorphoCell, MorphoSim, and MorphoBot.
- The platform aims to develop a reliable, efficient, and quantitative designing methodology for swarm robotics



FrC4(6) 16:45-17:00

Research on Robot-Assisted Bathing Based on Impedance Iterative Learning Sliding Mode Control Algorithm

Yuexuan Xu, Xin Guo, Yinglun Tan, Bokai Xuan, Tianyi Ma, Minghe Liu, Qingsong Ding, Jian Li, Hao Sun

Saturday Sessions

SaA2: Mobile Robotics I

Session Chair: Zhenzhong Liu

Room : Songjiang, 2F, 10:50-12:05, Saturday, July 30

SaA2(1) 11:00-11:15

Adaptive PID Trajectory Tracking Algorithm Using Q-Learning for Mobile Robots

Xiaoliang Fan, Jin Sui, Bi Zhang and Chunguang Bu*
Shenyang Institute of Automation,
Chinese Academy of Sciences, Shenyang, China

Classical PID controllers usually rely on some prior knowledge to manually adjust the gains of the controller and determine them. However, when the mobile robot works in a complex and changeable environment, the fixed PID gains may be difficult to meet the needs of the robot trajectory tracking accuracy. Therefore, this paper proposes a Q-learning-based adaptive PID trajectory tracking algorithm. Firstly, we construct a trajectory tracking Q-PID controller based on the error model of mobile robot. Then, the Q-learning algorithm is used to adaptively adjust the gains of the PID controller online. Meanwhile, the incremental active learning exploration method is used to improve learning efficiency and adaptability of agent. Finally, we use simulation experiments to verify the high performance of our algorithm.

SaA2(2) 11:15-11:30

Design of Two-Stage Passive Compliant of Wall-Climbing Robot with High Curvature Self-Adaptation

Zhenyu Yang, Yifeng Song, Hongguang Wang, Yong Chang, Fengren Jing
Shenyang Institute of Automation, Chinese Academy of Sciences, China
Zhenchun Deng
Shenyang Ligong University, China

- In the variable curvature environment, the robot has both adsorption stability and adaptability to the curvature wall.
- In the process of robot movement, the deformation and force of the sealing skirt are small, the load capacity is large, and the mobility flexibility is high.
- Robot has a certain obstacle-crossing ability and can smoothly cross local grooves and bulges.

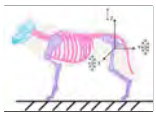
principle prototype

SaA2(3) 11:30-11:45

Configuration Synthesis of Leg Mechanism of Quadruped Robot of Deployable Mechanism

Boxuan Zhang
College of Mechanical and Electrical Engineering, NEFU, China
Zehao Yuan
College of Mechanical and Electrical Engineering, NEFU, China

- In order to solve the problem of the optimization of the joint of leg mechanism of the quadruped robot platforms, the leg mechanism of the quadruped robot platform is configured and synthesized. The kinematic chain type is constructed according to the geometric conditions and the restrained relationship, and through kinematics and dynamics simulating the constrained kinematic chain is optimized.
- configuration synthesis; constrained screw synthesis method; robot mechanism; kinematics

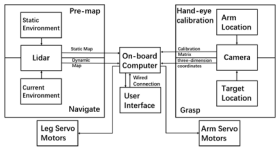


Motor function analysis

SaA2(4) 11:45-12:00

DogGet: A Legged Manipulation System in Human Environments

Linghan Meng, Cong Wang, Shengguo Cui, Qifeng Zhang and Baoqi Zhai



Facing the service tasks of seniors, there is no doubt that legged robots are the best choice for service tasks due to there flexibility and agility. However, complex service tasks require a mobile robotic system that integrates functions such as localization, navigation, recognition, and grasping. To this end, we propose a mobile robotic system to accomplish some daily service work such as finding and grasping some articles for daily use and then delivering them to a proposed place. We show that the system is universally applicable and highly efficient in daily environments by experiments.

SaA3: Robots and Learning

Session Chair: Tong Jia

Room : Baishan 1, 2F, 10:50-12:05, Saturday, July 30

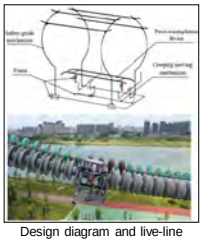
SaA3(1) 11:00-11:15

Development of a Robot for 500-kV EHV Power Transmission Lines Faulty Insulator

Tianyu Zhang[1,2,3], Hongguang Wang[1,2*], Xin'an Pan[1,2], Peng Lv[1,2], Lijuan Guo[4] and Yifeng Song[1,2]

[1]State Key Laboratory of Robotics, Shenyang Institute of Automation, Chinese Academy of Sciences, China
[2]Institutes for Robotics and Intelligent Manufacturing, Chinese Academy of Sciences, China
[3]University of Chinese Academy of Sciences, China
[4]Electric Power Research Institute of Guangxi Power Grid Co., China

- An insulator detection robot was designed, which moves along horizontal insulator strings and suspended insulator strings.
- This paper introduced its motion principle and analyzed its adaptability.
- The functionalities and characteristics of the robot were verified by lab test and field test.
- All tests suggest that the robot has such advantages as stability, adaptability, high detection efficiency, and strong anti-interference ability under 500-kV.



Design diagram and live-line test of the robot

SaA3(2) 11:15-11:30

Cause Analysis of Bolt Seizure Failure and Experimental Study On Influencing Factors

Xiaoyu Liu,Aixuan Zhang, Zhongwei Zhang*, Kai Liu, Xinggao Zhu and Weiliang Chen
China Astronautics Standards Institute,

- This paper analyzes the causes of thread seizure failure, and summarizes the main causes of bolt seizure failure. The thread connection combination of titanium alloy bolt and self-locking nut is selected, and the influence law of the main influencing factors (installation speed, installation preload, surface treatment and lubrication) on the seizure failure of threaded fasteners is studied by testing. It is found that the larger the installation speed and installation torque, the thread pair is more prone to occur seizure failure; The selection of appropriate surface treatment can improve the anti seizing ability of thread pair; Lubrication measures for threaded fasteners can effectively improve the anti seizure ability.

SaA3(3) 11:30-11:45

Research on Built-in power supply technology of AUV based on the wave energy

Fengmei JING，Song WANG and Yunlei MEI
College of Mechanical Engineering, Beijing Institute of Petrochemical Technology, Beijing
Xiongbo ZHENG，Mingze JI
College of Mathematics Science, Harbin Engineering University, Harbin

- This paper presents a built-in WEC device for underwater docking station.
- The inertial vibrator converts wave energy into electric energy through PTO system.
- The performance and the efficiency of the device was evaluated
- It can supply power for marine equipment, and has considerable application prospects.

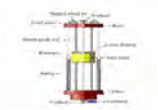


Fig.1 Structure diagram of the working principles of the WEC

SaA3(4) 11:45-12:00

Research status of phantom limb pain: based on CiteSpace analysis

Hong M. Liu, Zeng Y. Li, Yu B. Fan, Wei Y. Ren*, Hui Q. Luan*

- Objective The CiteSpace visual analysis software is used to explore the hotspots and frontiers of researches on phantom limb pain. Methods: Using literature visualization tool CiteSpace, we have analyzed the literature on "phantom limb pain" collected by English WOS database from 2000 to 2020, to summarize the status quo and trend of phantom limb pain research in the past two decades. Results: A total of 1542 international literatures are obtained. Researchers mainly focus on the pathological mechanisms and clinical treatment methods of different types of phantom limb pain. Furthermore, most authors prefer small-scale collaborative research. Most of academic achievements published by universities in Britain, Germany and the United States, and the United States is in a leading position in academic research. In addition, the classical and key literatures in the field of phantom limb pain mainly focus on the central nervous system, peripheral nervous system, cortical reorganization and other pathological mechanisms, as well as drug therapy and a variety of physical therapy. Conclusion: The CiteSpace-based analysis can provide a more objective and scientific understanding of the research status, hotspots and frontiers of phantom limb pain, which is of great significance to its future research.

SaA4: SLAM and Navigation

Session Chair: Jian Li

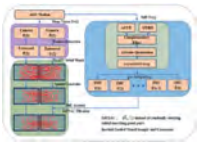
Room : Baishan 2, 2F, 10:50-12:05, Saturday, July 30

SaA4(1) 11:00-11:15

Image Feature Matching Based on Spatial Constraints and Inertial Assistance for AGV Navigation in Digital Workshops

Shijie Sun and Li Chen
School of Artificial Intelligence, Shenyang University of Technology, China
Wei Liang and Yinlong Zhang
Shenyang Institute of Automation, Chinese Academy of Sciences, China

- Spatial Constraints: delete the obvious false matches
- IAVSAC proposed by us: reduce the computational time in discriminating the wrong feature matches
- Handling the IMU: Complementary Filter and Pre-integration



SaA4(2) 11:15-11:30

A Robust Seabed Terrain Contour Aid Navigation Method Facing the Smooth Terrain

Wenjun Zhang, Dong Ma, Jingxuan Gao, Teng Ma, Yueyang Ben
Science and Technology on Underwater Vehicles Laboratory, Harbin Engineering University, China
College of Nautical and Naval Engineering, Dalian Ocean University, China

- A robust terrain contour aid navigation(TCAN) method facing the smooth terrain
- Considering the error characteristics of an inertial navigation system
- A terrain measurement confidence interval calculation method
- Can realize long-range underwater precise navigation in the smooth terrain areas

Architecture of the TCAN system

SaA4(3) 11:30-11:45

An Unmanned Vehicle Inspection System for Airport Runways

Liujuan Zhu, Guoliang Liu, Yichao Cao, Bin Huang and Guohui Tian
School of Control Science and Engineering, Shandong University, Jinan, China
Xiaobo Guo and Guangyu Hui
Chinese Flight Test Establishment, Xi'an, China

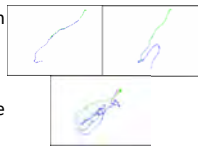
- Proposed a self-driving unmanned vehicle inspection system innovatively.
- Used dual lidar fusion to expand the detection range and reduce blind spots.
- Improved point cloud clustering algorithm.
- Integrated path planning, automatic cruise, foreign object detection and other functions.

SaA4(4) 11:45-12:00

Collaborative Visual Inertial SLAM with KNN Map Matching

Boyang Liu[1], Guoliang Liu[4] and Hongyu Lu[5]
School of Control Science and Engineering, Shandong University, China
Zihao Zhang[2] and Dongning Hao[3] and Yazhou Meng[6] and Xiang Lu[7]
Hisense Visual Technology Co.,Ltd., China

- A collaborative visual inertial SLAM system based on VINS-Fusion is proposed.
- The KNN Map Matching method is proposed to solve mismatch.
- The distance error is less than 5cm and the angle error is less than 5° on EuRoC dataset.



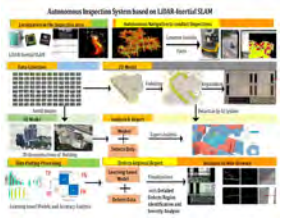
The fusion results on the EuRoC dataset

SaA4(5) 12:00-12:15

A Robust and Efficient LiDAR-Inertial-Visual Fused Simultaneous Localization and Mapping System with Loop Closure

Kangcheng Liu
Department of Mechanical and Automation Engineering, The Chinese University of Hong Kong, Hong Kong, China

- Firstly, we have proposed a tightly coupled LiDAR-Visual-Inertial fusion SLAM (LVI-SLAM) framework
- Secondly, we have proposed to project the images obtained in the VIO system into 3D to compensate the optimization errors caused by long-term drifting of LiDAR odometry
- Thirdly, we have proposed the front-end iterative Kalman Filter-based odometry for the tightly coupled front-end optimization of our LVI-SLAM system.



Overall System

SaB2: Mobile Robotics II

Session Chair: Jing Xu

Room : Songjiang, 2F, 13:30-14:45, Saturday, July 30

SaB2(1) 13:30-13:45

Map Creation of Indoor mobile Robot Based on Multi-sensor Fusion with Gradually Increasing Accuracy

Zhanghai Luo
Electronic Information Engineering, West Normal University, China
Zhengyong Feng
Electronic Information Engineering, West Normal University, China

- A SLAM method for three-step fusion of multi-sensor data is implemented.
- First step data fusion for wheel odometer and inertial measurement unit (IMU).
- Perform the first step data fusion and lidar data for the second step data fusion.
- Perform the third-step data fusion of the second-step data fusion and the depth camera data.

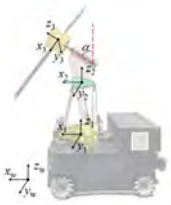
Multi-sensor triple fusion scheme

SaB2(2) 13:45-14:00

A Kinetic Simulation Mechanism of Torque-Free Satellites Based on A Mobile Parallel Manipulator

Hao Chi, Ken Chen and Jiwen Zhang
Department of Mechanical Engineering, Tsinghua University, China
Yu Liu and Shuli Liang
Beijing Institute of Tracking and Telecommunication Technology, China

- The simulation mechanism's kinetics and torque-free satellites' motion is analyzed.
- We develop an adaptive architecture to search the workspace with or without the mobile base.
- We propose a dynamic programming method to generate the mobile parallel manipulator's feasible and optimal trajectory.
- Experiment results verify the method's feasibility and effectiveness



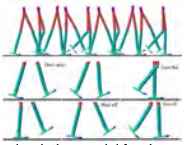
SaB2(3) 14:00-14:15

Human-like Walking of Biped Robot with Foot Rotation Using Passive Metatarsophalangeal Joint

Xiaolin Dai[1, 2], Yixiang Liu[1, 2], Xinyu Liu[3], Xizhe Zang[4], Rui Song[1, 2], and Yibin Li[1, 2]

1. School of Control Science and Engineering, Shandong University, Jinan 250061, China
2. Engineering Research Center of Intelligent Unmanned System of Ministry of Education, Jinan 250061, China
3. Jiangsu Automation Research Institute, Lianyungang 222000, China
4. State Key Laboratory of Robotics and System, Harbin Institute of Technology, Harbin 150080, China

- Passive metatarsophalangeal joint is added to the biped robot model.
- A walking controller based on finite state machine is proposed.
- The whole foot-ground contact process of human walking is simulated on the biped robot.



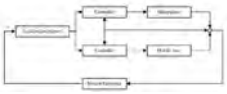
The simulation model for dynamic walking of the biped robot

SaB2(4) 14:15-14:30

Event based Motion Planning and Control for Mobile Manipulator

Jiajie Ye, Ma Ye, Siyu Wang, Kwok Chun, Qingyang Wang and Ning Xi*
Department of Industrial and Manufacturing Systems Engineering, The University of Hong Kong, Hong Kong, China

- A whole-body, event-based motion planning and control method for a non-holonomic, 6DOF mobile manipulator
- Mathematical modeling of the 6DOF mobile manipulator
- Synchronize the movement of the manipulator and the mobile base



Online synchronization control of the mobile base and manipulator

SaB2(5) 14:30-14:45

Development of a Crawling Robot for Large Steel Strcture Welding

Xiaoteng WANG
China Railway Construction Heavy Industries, China
Gang CHEN
College of information of science and Engineering, Jiaxing University, China

- A welding robot with six axis manipulator based on a crawler chassis is designed;
- A feature recognition method is adopted for the guidance of the crawling robot;
- Process control algorithm is optimized to guide the robot for real time positioning/welding;
- A girth weld of total length of 28.6 meters was welded by the robot.

crawling welding robot

SaB3: Mechanism and Control

Session Chair: Tong Jia

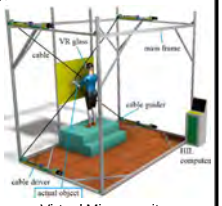
Room : Baishan 1, 2F, 13:30-14:45, Saturday, July 30

SaB3(1) 13:30-13:45

Research on Structure Design and Control of Plane 3-DOF Cable Driven Virtual Microgravity Training System

Feng Xue, Lixun Zhang, Chao Wang, Zhenhan Wang and Yuhe Fan
College of Mechanical and Electrical Engineering, Harbin Engineering University, China

- The system can realize the training of transporting objects in virtual microgravity environment
- Using parallel cables to drive object motion
- System structure design
- A control strategy using genetic algorithm to optimize the tension of flexible cable is proposed



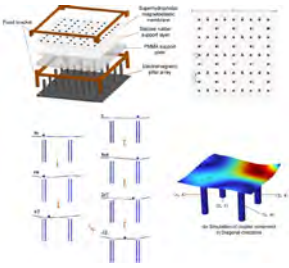
Virtual Microgravity Training System

SaB3(2) 13:45-14:00

Design of Programmable Droplet Manipulation Platform Based on Magnetic Control

Xianmiao Zhang[12], Jie Liu[12], Jiying Liu[3], Yuzhe Wang[12], Mian Zhang[12], Hongbiao Xiang[12]*
Tianjin Key Laboratory for Advanced Mechatronic System Design and Intelligent Control & National Demonstration Center for Experimental Mechanical and Electrical Engineering Education, Tianjin University of Technology, Tianjin, China

- Magnetic blocks with different magnetization directions were designed on the silicone rubber membrane.
- Magnetoelastic membrane deformed under the magnetic field generated by the array of electromagnetic pillars.
- Droplet can move lengthwise, widthwise, and diagonally in the horizontal plane, and multiple droplets can be merged and mixed.

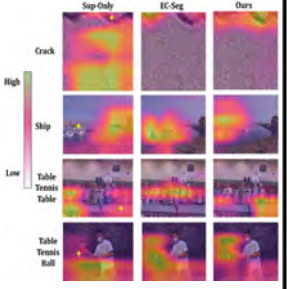


SaB3(3) 14:00-14:15

Semi-Supervised Confidence-Level-based Contrastive Discrimination for Class-Imbalanced Semantic Segmentation

Kangcheng Liu
Department of Mechanical and Automation Engineering, The Chinese University of Hong Kong, Hong Kong, China

- To achieve context awareness, we propose using context-aware pixel-level contrastive learning to make our model achieve prediction consistency under various of transformations.
- To achieve context consistency, we propose the first confidence-level based contrastive loss, which encourage the high-confident network predictions.
- To eliminating overfitting in the class-imbalanced segmentation, we propose the data balance loss to replace the traditional cross entropy loss.



Segmentation Attention Map

SaB3(4) 14:15-14:30

A Review of Formation Control Methods for MAUV Systems

Bofeng Fu
Information and Control Engineering,Jilin Institute of Chemical Technology, China
Gang Wang and Qiang Zhao and Yingjie Song
Mechanical and Control Engineering, Baicheng Normal University, China

- This paper combs the formation control methods commonly used in recent years.
- The advantages and disadvantages of these methods are introduced and compared.
- The future development prospect of MAUV formation control is discussed.

Suctech Motion Systems AUV

SaB3(5) 14:30-14:45

The mechanical properties and surface morphology of axillary crutches

Hong M. Liu[1,2], JI W. Duan[3], Zhong J. Mo[3], Hui Q. Luan[3]*, Yi Q. Luan[4]*
1.School of Biological Science and Medical Engineering, Beihang University, Beijing, China;
2. Rehabilitation Hospital Affiliated to National Research Center for Rehabilitation Technical Aids, Beijing, China;
3.National Research Center for Rehabilitation Technical Aids, Beijing, China;
4. Stainless steel plant , Shandong Taishan Steel Group Co., Ltd, JiNan, China.

• *Abstract*—To study the surface morphology and mechanical properties the side of bows of domestic axillary crutches in rehabilitation aids marketed. Methods According to the experimental principle, the static mechanical properties of three axillary crutches were detected by automation mechanical loading platform, the surface morphology of side bows of axillary crutches was observed by scanning electron microscope. Results There is no significant differences in the surface microcracks of the three samples. Sample B and C have cracks and permanent deformation on the side of the bows, while sample A has no cracks and deformation. Surface microcracks of axillary crutches have little effect on static mechanical properties. Using the automatic mechanical loading platform to do static loading experiments, the force loading position of the axillary crutches is in line with the actual application, and the experimental results are more intuitive.□

SaB4: Industrial Robotics and Applications

Session Chair: Jian Li

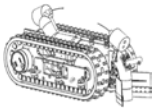
Room : Baishan 2, 2F, 13:30-14:45, Saturday, July 30

SaB4(1) 13:30-13:45

Mechanical Design of Crawler Hydraulic Sludge Cleaning Robot

Zhilin Yang, Haitao Fang, Wei Feng and Kai He
Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, Shenzhen
Yongqiang Wang
China Merchants Heavy Industry (Jiangsu)CO.,LTD, Nantong

- Structure and working principle of crawler hydraulic sludge cleaning robot.
- Rubber track selection
- Drive wheel design
- Design of pushing and lifting mechanism



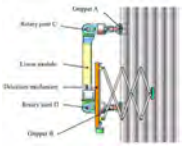
Robot model diagram

SaB4(2) 13:45-14:00

Mechanical Analysis of Superheater Pipe Detection Robot

Lei Zhang and Jianping Hou
Hebei Datang Wangtan Power Plant Co. LTD, China
Kaiqi Shi,Wentao Huang and Fengyu Yang
College of mechanical and electrical engineering, Harbin Engineering University , China

- This paper designs a pipe crawling detection robot.
- The mechanical structure and control system of the robot was designed.
- The gripper was analyzed with force closure.
- this paper analyzes the motion state and force condition of the robot by Adams software
- This paper conducts modal analysis on the climbing part of the robot body.

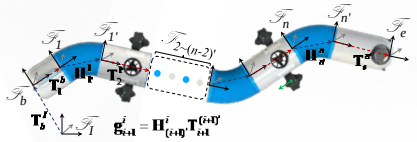


The Superheater Pipeline Detection Robot

SaB4(3) 14:00-14:15

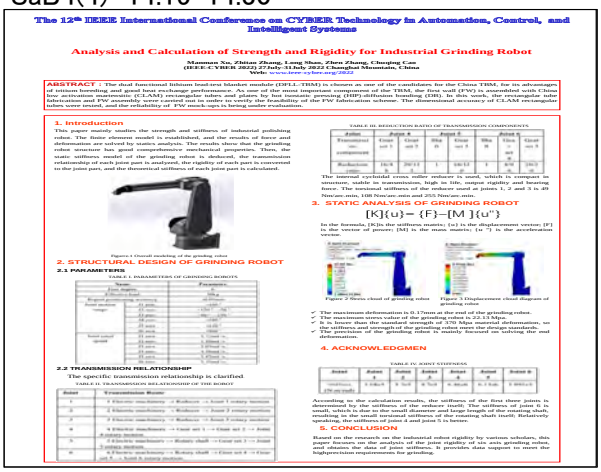
Hybrid Dynamic Modeling for an Underwater Rigid-Soft Snake Robot

Junhao Zhang, Yinglong Chen and Yongjun Gong
Dalian Maritime University



- A snake robot based on rigid propulsion and soft joint hybrid actuation is proposed, which takes into account the swimming efficiency and flexibility.
- The rigid–soft interactive dynamics modelling approach is proposed as a combination of rigid and soft members.
- The availability of the model are verified by simulating four cases.

SaB4(4) 14:15-14:30



The 12th IEEE International Conference on CYBER Technology in Automation, Control, and Intelligent Systems

Analysis and Calculation of Strength and Rigidity for Industrial Grinding Robot

Maonan Xu, Zhitao Zhang, Long Shao, Zhen Zhang, Chenping Cao
(IEEE CYBER 2022) 27July-31July 2022 Changbai Mountain, China
Web: www.ieee-cyber.org/2022

ABSTRACT : The dual functional bilateral load-sensitive double module (DFLL-TBM) is a beam as one of the candidates for the China TBM, for its advantages of robust bonding and good heat exchange performance. As the main components of the TBM, the first wall (FW) is assembled with China low activation martensitic (CLAM) rectangular tubes and plates by hot isostatic pressing (HIP) diffusion bonding (DB). In this work, the rectangular tube fabrication and FW assembly were carried out in order to verify the feasibility of the FW fabrication scheme. The dimensional accuracy of CLAM rectangular tubes were tested, and the reliability of FW mock-ups is being under evaluation.

1. Introduction

2. STRUCTURAL DESIGN OF GRINDING ROBOT

2.1 PARAMETERS

2.2 TRANSMISSION RELATIONSHIP

3. STATIC ANALYSIS OF GRINDING ROBOT

[K]{u}= {F}-[M]{u''}

4. ACKNOWLEDGMEN

5. CONCLUSION

SaC2: Machine Learning and Applications

Session Chair: Jing Xu

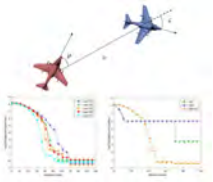
Room : Songjiang, 2F, 15:05-16:05, Saturday, July 30

SaC2(1) 15:30-15:45

Multiple UAVs Target Allocation via Stochastic Dominant Learning Pigeon-inspired Optimization in Beyond-visual-range Air Combat

Yangqi Lei, Mengzhen Huo, Yimin Deng, and Haibin Duan
School of Automation Science and Electronic Engineering, Beihang University, China

- Beyond-visual-range air combat
- Multiple unmanned aerial vehicles target allocation problem
- Cooperative target allocation model formulated by matrix game theory
- Stochastic adaptive learning pigeon-inspired optimization



Multiple UAVs target allocation

SaC2(2) 15:45-16:00

Research of Evaluation Method of Cleaning Performance forCleaning Robots Based on Machine Learning

Qing Huang ,Panchao Liu , Huimin Zeng and Ruiqi Zheng
Department of Research and Development, Center Testing International Group Co.,Ltd.(CTI), China

- This study proposes a evaluation method of cleaning performance for cleaning robots
- The stain recognition model established in this study can identify stains with high precision
- The evaluation model considers the multiple impact factors and the objective weight of each impact factor
- The evaluation model can further be used in different types of cleaning robots

Figure caption is optional, use Arial 18pt

SaC2(3) 16:00-16:15

A Teleoperated Manipulator Control System Based on Surface Electromyography Using Deep Learning

Zhiping Lai, Xueze Zhang, Junkongshuai Wang, Wei Mu, Aiping Wang, Lan Niu, Lihua Zhang, Hongbo Wang and Xiaoyang Kang
Institute of AI and Robotics, Fudan University, China

Framework of the sEMG-based teleoperated manipulator control system.

- Spatial-temporal convolutional network
- Majority voting

SaC2(4) 16:15-16:30

Initial value selection strategy of glide trajectory based on Legendre pseudospectral

Chuantao Ye , Zhiqin Liu and Jun Huang
School of Computer Science and Technology, Southwest University of Science and Technology, China

- The pseudospectral method is combined with the affine and sequential quadratic programming algorithms
- The introduction of the bionic algorithm reduces the number of iterations for problem solving.
- Reduces the possibility of solving the nonlinear programming problem due to bad initial value divergence

Integrated numerical model of x-51A similar vehiclen

SaC3: Intelligent Sensing and Control

Session Chair: Tong Jia

Room : Baishan 1, 2F, 15:05-16:05, Saturday, July 30

SaC3(1) 15:30-15:45

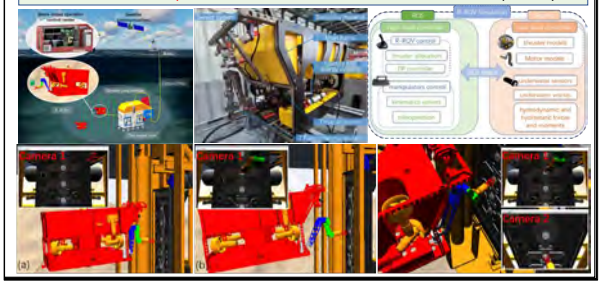
Development and Construction of a Simulation Platform for a New R-ROV

Xuejiao Yang, Qifeng Zhang, Cong Wang, Xiaomeng Liu, Yunxiu Zhang, Dehao Li

The Resident ROV (R-ROV) : Not limited by sea conditions, ultra-long umbilical cable

1. analyzes the dynamics of the R-ROV
2. constructs control system
3. builds the simulation platform.

1. reduces operator cognitive fatigue
2. provides an effective validation platform
3. shortens the research and development cycle

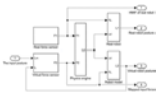


SaC3(2) 15:45-16:00

Virtual Human-machine Interaction Algorithm in Astronaut Virtual Training

Lingjie Lin, Lan Wang, Ying Chang
Lixun Zhang and Feng Xue
College of Mechanical and Electrical Engineering,
Harbin Engineering University, Harbin

- Virtual human-machine interaction force in the process of single person carrying objects
- The solution of VHMIF in the process of two people cooperating to carry objects
- Stability analysis of algorithm



SaC3(3) 16:00-16:15

Meal target detection based on improved YoloV3 algorithm

WenTao Huang, Lan Wang and Yan Li
Mechanical and Electrical Engineering, Harbin Engineering University, China

- Based on the improved Retinex algorithm, this paper preprocesses the dataset images.
- By adding AQ module and MQ prediction layer, this paper designs an improved Yolov3 model.
- The model improves accuracy by 4.15% and speed by 16.1% compared with the unimproved model.

Meal target detection

SaC4: Internet of Things

Session Chair: Xingyuan Wang

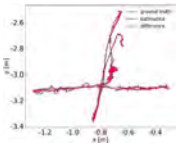
Room : Baishan 2, 2F, 15:05-16:05, Saturday, July 30

SaC4(1) 15:30-15:45

Dynamic SLAM Algorithm Fusing Semantic Information and Geometric Constraints

Dongyi Zhou
Shenyang Aerospace University. Shenyang Institute of Automation, Chinese Academy of Sciences, China.
Yong Chang,Kunlong Hong and Yifeng Song
Shenyang Institute of Automation, Chinese Academy of Sciences, China.

- The lightweight target detection network is selected and combined with orb-slam2 framework to realize real-time dynamic positioning.
- Outliers on dynamic objects are eliminated based on semantic information and geometric constraints.
- On the public tum data set, this algorithm is compared with the open source algorithm to verify the effectiveness of this algorithm.



Absolute trajectory error

SaC4(2) 15:45-16:00

A wearable remote real-time monitoring system for transmission line operation monitoring

Qinshu Chen
the School of Mechanical Engineering and Automation, Beihang University, China
Diansheng Chen
the School of Mechanical Engineering and Automation, Beihang University, China

- Real-time monitoring of Operation of maintenance personnel
- compression coding technology and streaming media transmission technology
- Wearable visual intercom terminal

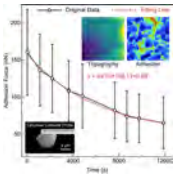
Figure caption is optional, use Arial 18pt

SaC4(3) 16:00-16:15

Usage of Colloidal AFM Probe for Research in Effects of Water Layer Evaporation on Interfacial Adhesion between Cellulose Surfaces

Junyuan Geng, Hao Zhang, Xianghe Meng, Haibo Gao, Weibin Rong and Hui Xie
The State Key Laboratory of Robotics and Systems, Harbin Institute of Technology, Harbin, China

- Preparing a cellulose colloidal AFM probe with micromanipulation;
- Time-dependent characterization of topography and interfacial adhesion between cellulose surfaces during water evaporation using AFM;
- This research is meaningful to adjustment of process parameters in paper or textile industry.



Time-dependent relationship of interfacial adhesion between cellulose surfaces with water evaporation

SaC4(4) 16:15-16:30

Research on DMP-based gait generation and control method for prosthetic limbs

Meiqi Liu, Bokai Xuan
School of Artificial Intelligence and Data Science, Hebei University of Technology, China
Yifei Liu, Yanli Geng
School of Artificial Intelligence and Data Science, Hebei University of Technology, China

- Analysis and modeling of human load-bearing walking lower limb motion
- Gait generation based on dynamic motion primitives
- Prosthetic testbed modeling based on the Lie group Lie algebra
- Sliding-Mode control-based control of a prosthetic testbed

Human model diagram

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