ICARM 2021

CONFERENCE DIGEST ›››

2021 6th IEEE International Conference on Advanced Robotics and Mechatronics

Chongqing, China

July 3-5, 2021

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WELCOME

On behalf of the IEEE ICARM 2021 Conference Organizing Committee, we are very pleased to welcome you to Chongqing University, China for the 2021 IEEE International Conference on Advanced Robotics and Mechatronics. We are proud to announce that the IEEE ICARM 2021 conference accepted 160 papers from 333 submissions, resulting in an acceptance rate of 48%. We should mention that the IEEE ICARM 2021 Program Committee worked extremely hard to review the paper submissions in order to maintain the quality of the conference. We regret that many excellent papers could not be included in the conference program.

IEEE ICARM 2021 is highlighted by 9 plenary/keynote speeches. The theme of ICARM 2021 is “Emerging robotics and mechatronics techniques in new era”. New challenges and technologies have thus become an important element in robotics and mechatronics research. It is important to discuss and formulate the direction of the frontier. IEEE ICARM 2021, hosted in Chongqing University, China, promises to offer participants a great experience with excellent technical and social programs.

We wish to express our appreciation and thanks to all the individuals who have contributed to IEEE ARM 2021 in a variety of ways. Special thanks are extended to our colleagues in the Program Committee for their thorough review of all the submitted papers, which is vital to the success of this conference. We must also extend our thanks to all the members in the Organizing Committee and our volunteer students who have dedicated their time and efforts and helping the conference. Last but not least, our special thanks go to distinguished plenary speakers, keynote speakers and all the authors for contributing their research work, and to the participants and the exhibitors in making the 2021 IEEE ARM a great event. Thank you and wish you a great conference experience and enjoyable stay in Chongqing.

Jun Luo
General Chair
Chongqing University, China

Hang Su
Program Chair
Politecnico di Milano, Italy

Jian Huang
Program Chair
Huazhong Univ. of Sci. and Tech., China

CONTENTS

2021 6th IEEE International Conference on Advanced Robotics and Mechatronics

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IEEE Robotics & Automation Society

IEEE Systems, Man and Cybernetics Society

IEEE RAS Technical Committee on Neuro-Robotics Systems

IEEE SMC Technical Committee on Bio-mechatronics and Bio-robotics Systems

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CONFERENCE INFORMATION

The IEEE International Conference on Advanced Robotics and Mechatronics (ICARM) is the flagship conference of both IEEE-SMC TC on Bio-mechatronics and Bio-robotics Systems, and IEEE-RAS TC on Neuro-Robotics Systems.

The ICARM 2021 will take place in the Chongqing University, Chongqing, China, from July 3rd to 5th, 2021. Chongqing University is a national key university directly under the administration of the Ministry of Education. It is one of the national "211 Project" and "985 Project" comprehensive and high-level research-oriented universities. It is also one of the national "World-class Universities (Class A)".

The conference will provide an international forum for researchers, educators, engineers in general areas of mechatronics, robotics, automation and sensors to disseminate their latest research results and exchange views on the future research directions of these fields.

Language

The official language of the conference is English.

Conference Registration

All conference attendees are required to register.

Registration fees are as follows:

Registration Type	**Early registration May 15 – June 15, 2021**	**Advance registration June 15 – July 2, 2021**	**Electronic Proceedings & Banquet**
IEEE Member	600 USD	700 USD	Yes
IEEE Student Member	500 USD	600 USD	Yes
No Member	700 USD	800 USD	Yes
No Student Member	600 USD	700 USD	Yes

*Conference registration fee includes admission to all technical sessions, lunches, dinners.

Onsite Registration Hours and Location

Date: July 2, 2021. Time: 13:00 -18:30. Venue: Empark Grand Hotel

CONFERENCE SCHEDULE

Friday, July 2, 2021		
13:00 - 18:30	Registration Desk Open	Empark Grand Hotel
Saturday, July 3, 2021		
Morning		
Location: Banquet Hall 2, Empark Grand Hotel		
08:30 -08:50	Opening Ceremony	**Host:** Jun Luo
08:50 -09:30	**Title:** Robot Skill Learning, Transfer and Enhancement for Dexterous Operation Applications **Speaker:** Fuchun Sun, Professor, Tsinghua University, China	**Host:** Jun Luo
09:30 - 10:10	**Title:** Data-Driven Evolutionary Optimization **Speaker:** Yaochu Jin, Professor, University of Surrey, UK	**Host:** Jun Luo
10:10 - 10:50	**Title:** Precise Robotic Enucleation to Increase Success Rate of Cloned Animal. **Speaker:** Xin Zhao, Chair Professor, Dean of Artificial Intelligence, Nankai University, Tianjin, China.	**Host:** Jun Luo
10:50 - 11:30	**Title:** Recent Advances in Evolutionary Transfer Optimization. **Speaker:** TAN Kay Chen, Professor, City University of Hong Kong, China	**Host:** Jun Luo
11:30 - 12:10	**Title:** Improved Reinforcement Learning with Applications in Robotics, Games and Quantum Control. **Speaker:** Daoyi Dong, Professor, University of New South Wales, Australia	**Host:** Jun Luo
12:10 - 14:00	Lunch Break	Golden Resources Cafeteria

Afternoon		
14:00 - 15:30	Regular Session SaPMA1: Award I	Banquet Hall 3
	Regular Session SaPMA2: Award II	Banquet Hall 4
	Regular Session SaPMA3: Award III	International Hall
	Regular Session SaPMA4: Award IV	No. 1 Conference Room
15:45 - 18:15	Regular Session SaPMR1: Modeling and Optimization	Banquet Hall 3
	Regular Session SaPMR2: Wearable Robot	Banquet Hall 4
	Regular Session SaPMR3: Neural Network Modeling	International Hall
	Regular Session SaPMR4: Intelligent Mechatronics	No. 1 Conference Room
18:30 - 20:00	Welcome Banquet	Banquet Hall 2
18:30 - 20:00	Dinner	Golden Century Chinese Restaurant
Sunday, July 4, 2021		
Morning		
Location: Banquet Hall 2, Empark Grand Hotel		
08:50 -09:30	**Title:** Symmetry in Underactuated Robots **Speaker:** Mark Yim, Professor, University of Pennsylvania	**Host:** Jian Huang
9:30 -10:10	**Title:** Bioinspired Underwater Robots and Their Applications **Speaker:** Junzhi Yu, Professor, College of Engineering, Peking University.	**Host:** Jian Huang

10:10 -10:50	**Title:** Cooperative Robot Control with Uncertainties: from Designing Human-Robot Cooperation to Mapping Human Motion Behavior, and Manipulating Micro/Nano Objects **Speaker:** Zhidong Wang, Professor, Chiba Institute of Technology, Japan	**Host:** Jian Huang
10:50 -11:30	**Title:** Recent Advances on Hand Rehabilitation Robots for Post-Stroke Patients **Speaker:** Long Cheng, Institute of Automation，Chinese Academy of Sciences, China.	**Host:** Jian Huang
12:00 - 14:00	Lunch Break	Golden Resources Cafeteria
Afternoon		
14:00 - 15:30	Regular Session SuPMR1: Adaptive Control	Banquet Hall 3
	Regular Session SuPMR2: Bionic Robotics	Banquet Hall 4
	Regular Session SuPMR3: Dynamics and Control	International Hall
	Regular Session SuPMR4: Imaging and Sensing	No. 1 Conference Room
15:45 - 18:15	Regular Session SuPMR5: Intelligent Learning and Control	Banquet Hall 3
	Regular Session SuPMR6: Locomotion Control	Banquet Hall 4
	Regular Session SuPMR7: Control System Modeling	International Hall
	Regular Session SuPMR8: Locomotion Control	No. 1 Conference Room
18:30 - 20:00	Award Banquet	Banquet Hall 2
18:30 - 20:00	Dinner	Golden Century Chinese Restaurant
Monday, July 5, 2021		
Morning		

9:00 – 11:00	Regular Session MoAMR1: Robot localization	Banquet Hall 3
	Regular Session MoAMR2: Trajectory Planning	Banquet Hall 4
	Regular Session MoAMR3: Unmanned Systems	International Hall
	Regular Session MoAMR4: Control System Modeling & Intelligent Learning and Control	No. 1 Conference Room
12:00-14:00	Lunch Break	Golden Resources Cafeteria

PLENARY-KEYNOTE TALK

Plenary-Keynote Talk:

July 3 8: 50 - 9: 30

Banquet Hall 2

Robot Skill Learning, Transfer and Enhancement for Dexterous Operation Applications

Fuchun Sun

Tsinghua University, China

Abstract: The development of artificial intelligence is gradually changing from scene intelligence dominated by open-loop learning to behavioral intelligence dominated by closed-loop learning. Behavioral intelligence not only emphasizes the perception and processing of simulated human brain information, but also emphasizes brain body co-development, i.e. perception and behavior as two physical processes coordinate with each other under the command of brain cognitive body, to solve the dynamic, interactive and adaptive problems of behavior learning in complex tasks. As the core of behavioral intelligence, skill learning for robot manipulations is a difficult and hot issue in current research field. In view of the problems that the existing skill learning methods do not make full use of the expert demonstrations and cannot achieve efficient policy learning, and the imitation learning algorithm is sensitive to the expert preference characteristics and the local manipulation space, this report introduces the theoretical and technical achievements in perception fusion of visual, tactile and acoustic information, imitation learning, skill transfer and enhancement of robot manipulation. Then, the application of skill transfer learning and enhancement technologies in operation of UAVs and robot dexterous manipulation will

be introduced. Finally, the development trend of robot manipulation skill learning will be discussed.

Biography: Dr. Fuchun Sun is professor of Department of Computer Science and Technology, President of Academic Committee of the Department, Tsinghua University, and deputy director of State Key Lab. of Intelligent Technology & Systems, Beijing, China. He serves as Vice Chairman of Chinese Association for Artificial Intelligence and Executive Director of Chinese Association for Automation. His research interests include robotic perception and skill learning，Cross-modal Learning and intelligent control. He has won the Champion of Autonomous Grasp Challenges in IROS2016 and IROS 2019. He is elected as IEEE Fellow and CAAI Fellow in 2019, CAA Fellow in 2020.

Dr. Sun is the recipient of the excellent Doctoral Dissertation Prize of China in 2000 by MOE of China and the Choon-Gang Academic Award by Korea in 2003, and was recognized as a Distinguished Young Scholar in 2006 by the Natural Science Foundation of China. He served as the EIC of the Journal of Cognitive Computation and Systems, and associated editors of IEEE Trans. on Neural Networks and Learning Systems during 2006-2010, IEEE Trans. On Fuzzy Systems since 2011, IEEE Trans. on Cognitive and Development Systems since 2018 and IEEE Trans. on Systems, Man and Cybernetics: Systems since 2015.

Plenary-Keynote Talk:

July 3 9: 30 - 10: 10

Banquet Hall 2

Data-Driven Evolutionary Optimization

Yaochu Jin

University of Surrey, UK

Abstract: Many real-world optimization problems are data-driven, where no analytical objective or constraint functions are available and time-consuming numerical simulations or expensive physical experiments must be done to perform optimization. Over the past two decades, data-driven surrogate-assisted evolutionary optimization has attracted increasing interest both in industry and academia. This talk will introduce the basic ideas of data-driven surrogate-assisted evolutionary optimization, present main advances, in particular in handling high-dimensional and many-objective problems, and discuss the remaining challenges. Applications of data-driven optimization, ranging from aerodynamic design optimization to deep neural architecture search will be given.

Biography: Professor Jin received the BSc, MSc, and PhD degrees from Zhejiang University, Hangzhou, China, in 1988, 1991, and 1996, respectively, and the Dr.-Ing. degree from Ruhr University Bochum, Germany, in 2001.

He is currently a Distinguished Chair, Professor in Computational Intelligence, Department of Computer Science, University of Surrey, Guildford, U.K., where he heads the Nature Inspired Computing and Engineering Group. He was a “Finland Distinguished Professor” of University of Jyvaskyla, Finland, a “Changjiang Distinguished Visiting Professor”, Northeastern University, China, and “Distinguished Visiting Scholar”, University of Technology Sydney, Australia. His main research

interests include data-driven surrogate-assisted evolutionary optimization, trustworthy machine learning, multi-objective evolutionary learning, swarm robotics, and evolutionary developmental systems.

Dr Jin is presently the Editor-in-Chief of the IEEE TRANSACTIONS ON COGNITIVE AND DEVELOPMENTAL SYSTEMS and the Editor-in-Chief of Complex & Intelligent Systems. He was an IEEE Distinguished Lecturer, and Vice President of the IEEE Computational Intelligence Society. He is the recipient of the 2018 and 2020 IEEE Transactions on Evolutionary Computation Outstanding Paper Award, the 2014, 2016, and 2019 IEEE Computational Intelligence Magazine Outstanding Paper Award, and the Best Paper Award of the 2010 IEEE Symposium on Computational Intelligence in Bioinformatics and Computational Biology. He is recognized as a Highly Cited Researcher 2019 and 2020 by the Web of Science Group. He is a Fellow of IEEE.

He obtained the BSc, MSc and PhD degrees from Zhejiang University, Hangzhou, China and the Dr.-Ing. from Ruhr-University Bochum, Germany. Before joining Surrey in 2010, he was a Principal Scientist with Honda Research Institute Europe, Germany. He did postdoctoral research with the Industrial Engineering Department, Rutgers, the State University of New Jersey, USA from 1998 to 1999. he was an Assistant and Associate Professor with the Electrical Engineering Department, Zhejiang University, Hangzhou, China from 1992 to 1996.

Plenary-Keynote Talk:

July 3 10: 10 - 10: 50

Banquet Hall 2

Precise Robotic Enucleation to Increase Success Rate of Cloned Animal

Xin Zhao

Nankai University, China

Abstract: The somatic cell nuclear transfer (SCNT), also known as animal clone, is one of most complex and challenging cell manipulation tasks. The SCNT involves multiple manipulation procedures, such as oocyte rotation, penetration, enucleation, and somatic cell injection, and inevitably causes intracellular damage to recipient oocytes during manipulation, resulting in only around 1-2% of reconstructed embryos developed into live cloned animals. The low success rate has become the major obstacle to extensive applications of the SCNT. In this talk, the automated polar body detection and nuclei visualization techniques were developed to perform precise enucleation through reducing the amount of lost cytoplasm in enucleation. Then, a robotic SCNT system was established and applied to pig cloning. We did thousands of robotic SCNT operations and transferred 510 reconstructed embryos to 6 pigs, and obtained 17 cloned pigs at last. Compared to manual SCNT methods, the blastocyst rate of our system was improved from 10% to 21%, the clone success rate was improved from 1-2% to 3.3%.

Biography: Prof. Zhao received the B.S. degree from Nankai University, Tianjin, P.R.China, in 1991, the M.S. degree from Shenyang Institute of Automation, CAS, Shenyang, P.R.China, in 1994 , and the Ph.D. degree from Nankai University, in 1997, all in control theory and control engineering. He joined the faculty at Nankai University,

Tianjin, P.R.China in 1997. He was a Visiting Professor in Center of Cell Control, Dept. of Mechanical & Aerospace Engineering, University of California at Los Angeles in 2009-2010. His research interests are in Mico-Nano Manipulation and System and Mathematical Biology. Prof. Zhao was the recipient of 1999 Excellent Professor Award, Nankai University, 2000 Inventory Prize, Tianjin Municipal Government, 2002 Excellent Professor Award of "College Key Teachers Fund", Ministry of Education, 2002 Excellent Professor Award of "Baogang Fund" and 2007 Program for New Century Excellent Talents in University, Ministry of Education. His team was supported by High Level Innovation Team in Tianjin Special Support Plan for Talents Development and Tianjin Key Areas Innovation Team (2017). His team conducted the first batch of robotic-operated alive cloned animals around the world in 2017 and received the Award of China's 10 Advancements in Intelligent Manufacturing Science and Technology in 2018.

Plenary-Keynote Talk:

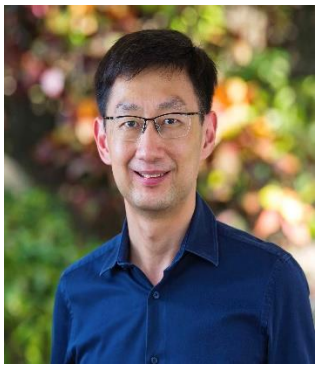
July 3 10: 50 - 11: 30

Banquet Hall 2

Recent Advances in Evolutionary Transfer Optimization

TAN Kay Chen

City University of Hong Kong, China



Abstract: It is known that the processes of learning and the transfer of what has been learned are central to humans in problem-solving. However, the study of optimization methodology which learns from the problem solved and transfer what have been learned to help problem-solving on unseen problems, has been under-explored in the context of evolutionary computation. This talk will touch upon the topic of evolutionary transfer optimization (ETO), which focuses on knowledge learning and transfer across problems for enhanced evolutionary optimization performance. It will first present an overview of ETO for problem-solving in evolutionary computation. It will then introduce our recent work on ETO for evolutionary multitasking which is an emerging search paradigm in the realm of evolutionary computation that conducts evolutionary search concurrently on multiple search spaces corresponding to different tasks or optimization problems. It will end with a discussion of future ETO research directions, covering various topics ranging from theoretical analysis to real-world complex applications.

Biography: Prof. Kay Chen Tan is currently a Chair Professor (Computational Intelligence) of the Department of Computing, the Hong Kong Polytechnic University. He has co-authored 7 books and published over 200 peer-reviewed journal articles.

Prof. Tan is currently the Vice-President (Publications) of IEEE Computational Intelligence Society, USA. He was the Editor-in-Chief of IEEE Transactions on Evolutionary Computation from 2015-2020 (IF: 11.169) and IEEE Computational Intelligence Magazine from 2010-2013 (IF: 9.083). Prof. Tan currently serves as an Associate Editor of various international journals, such as IEEE Transactions on Artificial Intelligence, IEEE Transactions on Cybernetics, and IEEE Transactions on Games.

Prof. Tan has been invited as a Plenary/Keynote speaker for many international conferences, including the 2020 IEEE World Congress on Computational Intelligence, the 2016 IEEE Symposium Series on Computational Intelligence, etc. He has served as an organizing committee Chair/Co-Chair for many international conferences, including the General Co-Chair of 2019 IEEE Congress on Evolutionary Computation, and the General Co-Chair of 2016 IEEE World Congress on Computational Intelligence, etc.

Prof. Tan has received a number of research awards, such as the 2020 IEEE Transactions on Cybernetics Outstanding Paper Awards, the 2019 IEEE Computational Intelligence Magazine Outstanding Paper Awards, the 2016 IEEE Transactions on Neural Networks and Learning Systems Outstanding Paper Awards, the 2012 Outstanding Early Career Award presented by the IEEE Computational Intelligence Society.

Plenary-Keynote Talk:

July 3 11: 30 - 12: 10

Banquet Hall 2

Improved Reinforcement Learning with Applications in Robotics, Games and Quantum Control

Daoyi Dong

University of New South Wales, Australia

Abstract: Reinforcement learning (RL) addresses the problem of how an autonomous active agent can learn to approximate an optimal behavioral strategy while interacting with its environment. It has been widely applied in various areas including artificial intelligence, control engineering, operations research and robotics. In this talk, we will introduce several improved reinforcement learning algorithms which were developed by my collaborators and myself. These algorithms include incremental reinforcement learning, quantum reinforcement learning, quantum-inspired deep reinforcement learning. We will also demonstrate several applications of these improved reinforcement learning algorithms to robotics, games and quantum control.

Biography: Professor Dong is currently a Scientia Associate Professor at the University of New South Wales, Canberra, Australia, and he is also an Alexander von Humboldt Fellow. He was with the Chinese Academy of Sciences and with the Zhejiang University. He had visiting positions at Princeton University, USA, RIKEN, Japan and the University of Hong Kong, Hong Kong, and University of Duisburg-Essen, Germany. He received a B.E. degree in automatic control and a Ph.D. degree in engineering from the University of Science and Technology of China, in 2001 and 2006, respectively. His research interests include machine learning and quantum control. He

was awarded an ACA Temasek Young Educator Award by the Asian Control Association and is a recipient of an International Collaboration Award, Discovery International Award and an Australian Post-Doctoral Fellowship from the Australian Research Council, and Humboldt Research Fellowship from Alexander von Humboldt Foundation in Germany. He serves as an Associate Editor of IEEE Transactions on Neural Networks and Learning Systems, and Technical Editor of IEEE/ASME Transactions on Mechatronics. He has also served as General Chair or Program Chair for several international conferences, and is currently Associate Vice-President and a Member-at-Large of Board of Governors, IEEE Systems, Man and Cybernetics Society. He has published 105 journal papers in leading journals including Nature Human Behaviour, Physical Review Letters, IEEE Transactions, and Automatica, and more than 50 conference paper. He has attracted a number of competitive grants with more than AU$2.8 million from Australia, USA, China and Germany.

Plenary-Keynote Talk:

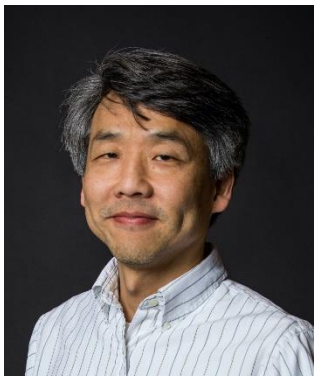
July 4 8: 50 - 9: 30

Banquet Hall 2

Symmetry in Underactuated Robots

Mark Yim

University of Pennsylvania, USA



Abstract: Symmetry is often thought of as natural, desirable or elegant in many engineered systems. In robotics, it often leads to compact efficient control and computation. Underactuated robots effectively control more degrees of freedom than the number of actuators. This can lead to lower cost systems with interesting engineering puzzles to solve with interesting questions: Can you control a drone to fly in 3D space with just one motor? Can you make a robot gripper that has no motors? Can diff-drive be holonomic? The presented devices and systems taken as a whole result in general principles that guide cost-effective systems which all share one aspect – a lack of symmetry.

Biography: Mark Yim is the Asa Whitney Professor of Mechanical Engineering in the School of Engineering and Applied Science. Yim is the director of the GRASP Lab, the oldest robotics research laboratory in the country established in 1980. His research group designs and builds a variety of electromechanical hardware. Demonstrations range from a humanoid robot on display at the Philadelphia Museum of Art to transforming robots that can change their shape to the smallest self-powered flying robot in the world. His other research interests include product design, robotic performance art, novel locomotion, low-cost manipulation, in the search and rescue as well as healthcare applications. Honors include the Lindback Award for Distinguished

Teaching (UPenn's highest teaching honor); induction to MIT's TR100 in 1999; induction to the National Academy of Inventors. He has over 200 publications and over 50 patents issued (perhaps the most prominent patents are related to the video game vibration control which resulted in over US$100 million in litigation and settlements). He has started three companies, one in robotics and one medical device company making a steerable needle and one focused on thermal storage.

Plenary-Keynote Talk:

July 4 9: 30 - 10: 10

Banquet Hall 2

Bioinspired Underwater Robots and Their Applications

Junzhi Yu

Peking University, China

Abstract: Robotic fish, inspired by fish in nature, have drawn much attention in the last two decades. As an excellent research and experimental platform, robotic fish not only plays an important role in helping biologists to investigate the kinematic mechanism and hydrodynamic analyses, but also is employed by engineers to explore practical, versatile and flexible propulsive mechanisms since natural fish have acquired such surprised swimming skills characterized by high effectiveness, high maneuverability, and low noise. Since the first robotic fish, RoboTuna, was created at MIT in 1994, more and more robotic fish prototypes have been developed to explore the high efficiency and high maneuverability in fishlike swimming. In this talk, I will first introduce the main motion characteristics of real fish and summarize a general research technical route for the bioinspired robotic fish. Then, on the basis of our recent research achievements in biomimetic robotic fish and robotic dolphin, I will emphatically elaborate the analysis and control for high-efficiency and high-maneuverability motion of the robotic fish and robotic dolphin. Remarkably, acrobatic flips and leaps which are first implemented by the physical robots will also be detailed. In additional, some aquatic scenario related applications will be mentioned.

Biography: Junzhi Yu received the B.E. degree in safety engineering and M.E. degree in precision instruments and mechanology from the North University of China, Taiyuan, China, in 1998 and 2001, respectively, and the Ph.D. degree in control theory and control engineering from the Institute of Automation, Chinese Academy of Sciences, Beijing, China, in 2003. From 2004 to 2006, he was a Postdoctoral Research Fellow with the Center for Systems and Control, Peking University, Beijing. He was an Associate Professor with the Institute of Automation, Chinese Academy of Sciences in 2006, where he became a Full Professor in 2012. He was an AvH research fellow with the University of Hamburg, Germany, from September 2009 to September 2011. In 2018, he joined the College of Engineering, Peking University, as a Tenured Full Professor.

For his achievements in swimming robots, Dr. Yu received the Outstanding Young Investigator Award from the National Natural Science Foundation of China and a National Natural Science Award, China, in 2017. In 2020, he was elected Fellow of IEEE through the Robotics and Automation Society. He has authored or coauthored more than 100 peer-reviewed international journal papers and five monographs in the areas of bioinspired swimming robots, motion control, and visual perception. He serves or has served as an associate editor for IEEE Transactions on Robotics, IEEE/ASME Transactions on Mechatronics, Bioinspiration & Biomimetics, Journal of Bionic Engineering, etc. His research interests include intelligent robots, motion control, and intelligent mechatronic systems.

Plenary-Keynote Talk:

July 4 10: 10 - 10: 50

Banquet Hall 2

Cooperative Robot Control with Uncertainties: from Designing Human-Robot Cooperation to Mapping Human Motion Behavior, and Manipulating Micro/Nano Objects

Zhidong Wang

Chiba Institute of Technology, Japan

Abstract: Controlling multiple autonomous robots and human-robot system in coordination are interesting and challenging research topics, especially to the mobile robot system without explicit inter-robot communication. In this talk, two robot systems having physical interactions among humans and robots will be introduced. In these systems, each robot is controlled as if it has a specified impedance dynamics, and a leader-follower type control algorithm is incorporated for estimating the human/leader robot desired motion based on the intentional force/moment applied by the human and the information of an environment. A Dance robot system is mainly designed for human intention estimation and skill evaluation as a whole-body motion with knowledge based system and dynamic interaction. These examples will inspire possible applications of the human-robot interaction in near future.

Recently, we also proposed a concept and architecture of Human Motion Map by representing extracted human behavior in the human living space as a map, by using human state estimation function and mapping function of SLAM. The concept is

implemented in a mobile robot system as a high dimensional map structure with multi-layer representing some basic motions of human being in particular place in the map, which is generated from individual observations of hundred's experiments. A motion feature descriptor is developed based on Human Motion Map for representing various walking behaviors in indoor environments and applying machine learning architectures. Furthermore, some recent results on caging based cooperative micro-bubble robot control for living cells microassembly, nano scale SLAM based localization with local-scan method, and nano-partical manipulation with nano-hand strategy will be presented for coping with significant uncertainties in cooperative micro/nano object handling.

Biography: ZhiDong Wang received his Bachelor of Engineering from Beihang University, China in 1987, and received his Master degree and Ph.D in Engineering from Tohoku University, Japan in 1992 and 1995 respectively. From 1995, he joined the Advanced Robotics Laboratory and later the Intelligent Robotics Laboratory at Tohoku University as an assistant and associate professor respectively. From 2006, he joined the Department of Advanced Robotics, Chiba Institute of Technology, and is currently professor and head of Biomimetic Systems Lab. at CIT, Japan.

Dr. Wang has published numerous journal and conference articles. He and his colleague received several best paper awards including the 2014 ROBIO Best Paper in Robotics Award, the JSME Award for best paper in 2005, and 2005 IROS Cyberbotics Award for Best Paper in Experimental Robotics, 2019 ROBIO Best Paper in Robotics Award. He served several academic meetings and was General Chair of ROBIO2011, Cyber2014, a Program Chair of ROBIO2007, Nanomed2016, and Program Co-Chair of ICRA2011, IROS2013. He will serve General Chair of ICRA2024 at Yokohama, Japan. Currently, he is serving the Vice President of ESPB and Associate Vice President of CAB of IEEE Robotics and Automation Society. His main research interests are human-robot interaction, distributed robotics, nano-manipulation, and application of cooperative robotics.

Plenary-Keynote Talk:

July 4 10: 50 - 11: 30

Banquet Hall 2

Recent Advances on Hand Rehabilitation Robots for Post-Stroke Patients

Long Cheng

Institute of Automation, Chinese Academy of Sciences, China.

Abstract: Post-stroke patients pay most attention to the upper-/lower-limb rehabilitation and neglect the rehabilitation training of the hand. However, hand is the most important execution organ of human beings, which plays a critical role in daily lives. Meanwhile, the area charging the hand motor in the human's brain is large. Therefore, the study on the hand rehabilitation robot can help the function recovery of patients' hands and improve their brain plasticity, which is valuable theoretically and practically. This talk is going to introduce the mechanism design and optimization techniques of the motion-compatible hand rehabilitation robot to ensure the comfortable and safe use of the robot. In addition, some novel impedance control algorithms are presented to realize the passive/active rehabilitation training.

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 currently serving as an Associate Editor/Editorial Board Member of IEEE Transactions on Cybernetics, Neural Processing Letters, Neurocomputing, International Journal of Systems Science, and Acta Automatica Sinica. His current research interests include the rehabilitation robot, intelligent control and neural networks.

Saturday
July 3, 2021

14:00 - 15:30	Regular Session SaPMA1: Award I	Banquet Hall 3
	Regular Session SaPMA2: Award II	Banquet Hall 4
	Regular Session SaPMA3: Award III	International Hall
	Regular Session SaPMA4: Award IV	No. 1 Conference Room
15:45 - 18:15	Regular Session SaPMR1: Modeling and Optimization	Banquet Hall 3
	Regular Session SaPMR2: Wearable Robot	Banquet Hall 4
	Regular Session SaPMR3: Neural Network Modeling	International Hall
	Regular Session SaPMR4: Intelligent Mechatronics	No. 1 Conference Room

SaPMA1: Award Session I

Session Chairs: Qimin Li, Chongqing University, China

Huayan Pu, Chongqing University, China

Empark Grand Hotel, Banquet Hall 3, 14:00 - 15:30, Saturday, July 3, 2021

SaPMA1.1 **ID: 13** 14:00 - 14:15

Hybrid Obstacle-Surmounting Gait for Hexapod Wheel-Legged Robot in Special Terrain

Ruoxing Wang, Zhihua Chen, Kang Xu, Shoukun Wang, Junzheng Wang and Bin Li
State Key Laboratory of Intelligent Control and Decision of Complex Systems, School of Automation, Beijing Institute of Technology, Beijing 100081, China

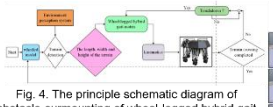


Fig. 4. The principle schematic diagram of obstacle-surmounting of wheel-legged hybrid gait

- The strategy of wheel-legged hybrid gait crossing gully terrain is designed, as shown in Figure 4.
- The Co-simulation based on MATLAB and V-REP is carried out, as shown in Figure 6.

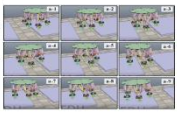


Fig. 6. The simulation scene and process of obstacle-surmounting gait of the robot

SaPMA1.2 **ID:17** 14:15 - 14:30

Control strategy at different instrument points using lever model in laparoscopic surgery

Lin Dong and Guillaume Morel
ISIR, Sorbonne Universite, France

- Lever effect is an important phenomenon in laparoscopic surgery, posing difficulties to surgeons.
- For compensation, we establish lever model to implement viscosity control at points on instrumental axis.
- We conduct point-to-point movement experiments to compare the controller (H or T) performance.
- Controller performance depends on instrument insertion depth into the trocar.

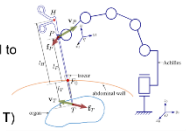


Illustration of lever model

SaPMA1.3 **ID:53** 14:30 - 14:45

Deep Reinforcement Learning with New-Field Exploration for Navigation in Detour Environment

Jian Jiang and Junzhe Xu
College of Computer Science and Technology, Zhejiang University of Technology, China
Jianhua Zhang and Shengyong Chen
School of Computer Science and Engineering, Tianjin University of Technology, China

- Propose a NFE mechanism and prove the method is effective for robot navigation task
- Evaluate the performance of NFE mechanism in several large simulated environments
- Build the simulation environment as robot navigation environment for algorithm comparison.

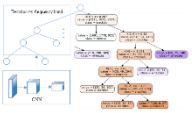
The agent is trained to navigate from initial position (red circle) to target position (green star)

SaPMA1.4 **ID:58** 14:45 - 15:00

Interpretable Respiratory Sound Analysis with Ensemble Knowledge Distillation

Cheng Wang, Jianqiang Li*, Jie Chen, Li Wang and Zun Liu
College of Computer Science and Software Engineering, Shenzhen University, China
Heng Zhang
Department of Respiratory and Critical Care Medicine, Shenzhen People's Hospital, China

- A novel respiratory sound analysis framework with interpretable ensemble knowledge distillation.
- Learn from multi sources dataset to overcome the challenge of poor generalization ability caused by only training small datasets.
- The model is more effective and interpretable.



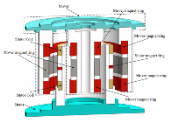
Interpretable CNN with tree regularization

SaPMA1.5 **ID:73** 15:00 - 15:15

A Novel Tunable Electromagnetic Gravity Compensator with Low Natural Frequency for Precision Assembly

Qimin Li, Tong Wang, Huayan Pu, Jin Yi, Jie Ma, Ruqing Bai
College of Mechanical and Vehicle Engineering, Chongqing University, China
Jinglei Zhao and Jun Luo
College of Mechanical and Vehicle Engineering, Chongqing University, China

- A novel topology of gravity compensator based on magnetic levitation technology
- Analytical model of levitation force and stiffness is established and validated
- A hybrid optimization strategy is utilized to optimize dimensional parameters for preferable mechanical performance
- Optimized gravity compensator can be deployed in various precision engineering for superior vibration isolation performance



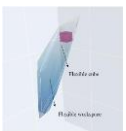
The basic structure of gravity compensator

SaPMA1.6 **ID:75** 15:15 - 15:30

Optimal Design of 6-DOF Parallel Manipulator with Workspace Maximization using a Constrained Differential Evolution

Huayan Pu, Hao Cheng, Jie Ma, Jin Yi, Jinglei Zhao, ZhiJiang Xie, Jun luo
College of Mechanical and Vehicle Engineering, Chongqing University, China

- Analyzed the 6-PSS parallel manipulator kinematically and dynamically
- Formulated the optimization model of flexible workspace of the 6-PSS parallel manipulator
- Differential evolution algorithm and genetic algorithm were proposed, and the results were compared
- Results showed DE was 48.3% better and 9.3% faster in solution providing and time consuming



Visualization of the optimized flexible workspace

SaPMA2: Award Session II

Session Chairs: Guang Chen, Tongji University, China

Jiateng Wang, Soochow University, China

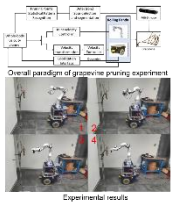
Empark Grand Hotel, Banquet Hall 4, 14:00 - 15:30, Saturday, July 3, 2021

SaPMA2.1 **ID:92** 14:00 - 14:15

Whole-Body Control on Non-holonomic Mobile Manipulation for Grapevine Winter Pruning Automation

Tao Teng[1,2], Miguel Fernandes [1], Matteo Gatti [2], Stefano Poni [2], Claudio Semini [1] , Darwin Caldwell [1], Fei Chen [3]
IIT[1], UCSC[2], CUHK[3]

- Kinematic and Dynamic Modeling of Non-holonomic Mobile Manipulation (Rolling Panda).
- Whole-body coordinated motion control for Rolling Panda.
- A task priority coordinated motion of Rolling Panda is guaranteed
- Grapevine Winter Pruning Automation concept proof.

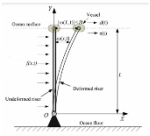


SaPMA2.2 **ID:94** 14:15 - 14:30

Neural Network Vibration Control of a Flexible Riser With Output Constraint

Fengjiao Liu and Yu Liu
School of Automation Science and Engineering, South China University of Technology, China

- An infinite dimensional model of a flexible riser presented by hybrid PDE-OEDs is employed.
- Boundary neural network control scheme for the flexible riser is designed.
- Adaptive neural network is adopted to cope with the uncertainty of the riser .
- The closed-loop system stability and the boundedness of the system states are proved by Lyapunov theory.


Flexible riser system

SaPMA2.3 **ID:107** 14:30 - 14:45

Design and its Application of Novel Anti-deflection Continuous Robot Skeleton

Changqu Wu, Zhiwei Qiu, Wenbiao Wang, and Guanjun Bao
College of Mechanical Engineering,Zhejiang University of Technology, China

- Principle of anti - deflection skeleton modules
- Structure design of anti - deflection
- Experiments of soft arm with anti - deflection skeleton

SaPMA2.4 **ID:110** 14:45 - 15:00

A lower-body exoskeleton platform with remote actuation

Faraz Shafi, Zohaib Aftab, Musharraf Hanif and Zafar Ali
Faculty of Engineering, Human-centered robotics lab, University of Central Punjab, Lahore, Pakistan

- To answer open questions regarding the design of exoskeletons, a versatile platform is developed for fast prototyping
- 400W off-board AC motors power the hip and knee joints
- Lightweight aluminum structure connects to the body via form-fitting thermoplastic interfaces
- Electrical systems and control hierarchy to operate the motors is also presented

SaPMA2.5 **ID:118** 15:00 - 15:15

Efficient and Robust Line-based Registration Algorithm for Robot Perception Under Large-scale Structual Scenes

Guang Chen Jinhu Dong Lijun Zhang and Haotian Liu
School of Automotive Studies, Tongji University, China
Yinlong Liu and Alois Knoll
Technical University of Munich, Germany
Bo Zhang
Shanghai Westwell Information and Technology Company Ltd, China

- A line-based efficient and robust algorithm is proposed for the registration of large-scale point clouds.
- Decoupled rotation and translation sub-problems are globally solved by branch-and-bound scheme.
- Proposed algorithm outperforms state-of-the-art local and global methods, while finds the robust pose more reliably.

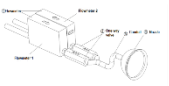

The flow diagram of the proposed registration algorithm

SaPMA2.6 **ID:126** 15:15 - 15:30

Design of A Tidal Volume Measurement Device for Respiration Tracking of Radiosurgrical Robots

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

- A real-time tidal volume measuring device was proposed to measure the expiratory and inspiratory processes independently.
- The design avoids the tidal volume measurement error caused by the difference between expiratory process and inspiratory process.
- The segmented tidal volume measurement is potentially feasible for the establishment of respiration tracking models.


Design of the tidal volume measurement device

SaPMA3: Award Session III

Session Chairs: Bin Fang, Tsinghua University

Jin Huang, University of Science and Technology of China, China

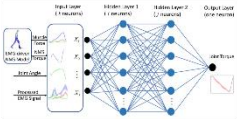
Empark Grand Hotel, International Hall, 14:00 - 15:30, Saturday, July 3, 2021

SaPMA3.1 **ID:129** 14:00 - 14:15

Estimation of ankle dynamic joint torque by a neuromusculoskeletal solver-informed NN model

Longbin Zhang[1,2], Xueyu Zhu[3],
Elena M. Gutierrez Farewik[1,2,4], and Ruoli Wang[1,2,4*]
[1]Department of Engineering Mechanics, KTH Royal Institute of Technology, Stockholm, Sweden.
[2]KTH MoveAbility Lab and KTH BioMEx Center, Stockholm, Sweden.
[3]Department of Mathematics, University of Iowa, Iowa City, Iowa
[4]Karolinska Institutet, Department of Women's and Children's Health, Stockholm, Sweden.

- The NMS solver informed-ANN model had a better torque prediction performance than both the NMS and the standard ANN models.
- We are the first attempt to integrating NMS and NN models in joint torque prediction, showing great potentials in exoskeleton rehabilitation controller design.



The architecture of NMS-solver-informed NN model

SaPMA3.2 **ID:133** 14:15 - 14:30

Modified Prototypical Networks for Few-Shot Text Classification Based on Class-Covariance Metric and Attention*

Yang Jun, Bin Wang, Ming Huang,Xin Yuan, Huaping Liu

SaPMA3.3 **ID:135** 14:30 - 14:45

MRI-compatible Hydraulic Drive Needle Insertion Robot

Qiu Yufu, Wu Longfei, Huang Fang, Huang Zhifeng, Yan Qiusheng and Guo Jing
Department of Automation, Guangdong University of Technology, China

- 6 DOF robotic system
- Hydraulic drive system based on communicating vessels.
- Scotch yoke and MRI-compatible encoder (linear resolution 0.7mm, angle resolution 1°)
- Mean linear positioning error: 0.88mm, angle positioning error: 1.48°

SaPMA3.4 **ID:139** 14:45 - 15:00

Whole-body Spatial Teleoperation Control of a Hexapod Robot in Unstructured Environment

Junling Fu, Junhao Zhang, Salih Ertug Ovur, Giancarlo Ferrigno, and Elena De Momi
Department of Electronics, Information and Bioengineering, Politecnico di Milano, Italy.
Wen Qi and Hang Su
Department of Electronics, Information and Bioengineering, Politecnico di Milano, Italy.
University of Science and Technology of China, China.
Ziyu She
School of Mathematics, Sun Yat-sen University, China.
Wenjie Li
Beijing Microelectronics Technology Institute,China.

- The kinematics of the hexapod is analyzed and the gaits of the hexapod robot is planned;
- Teleoperation control of the hexapod robot in unstructured environment is investigated;
- Experiments are implemented to demonstrate the feasibility and performance of the proposed teleoperation control system;

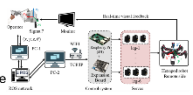


Figure.1 Teleoperation control system

SaPMA3.5 **ID:145** 15:00 - 15:15

A novel humanoid soft hand with variable stiffness and multi-modal perception

Bin Fang, Qingchao Wang, Shixin Zhang, Ziwei Xia, Fuchun Sun, Xiao Lu, Yiyong Yang and Licheng Wu
Department of Computer Science and Technology, Tsinghua University

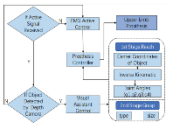
- A novel five-finger soft hand is proposed. The layer jamming structure is used to increase stiffness and the vision-based tactile sensor is used to provide perception in the soft hand.
- The results show that the soft hand can effectively transmit into different grasping modes and adaptively grasp objects of different shapes.
- The tactile data is collected by the sensor and a recognition model is built. Through the test, the accuracy is up to 98.75%.

SaPMA3.6 **ID:148** 15:15 - 15:30

Development and Hybrid Control of an Upper Limb Prosthesis for Reach and Grasp Motions

Jin Huang, Guoxin Li, Qingsheng Meng, Haisheng Xia, Zhijun Li
the Department of Automation, University of Science and Technology of China, Hefei,China
Yueyue Liu
the School of Automation Science and Engineering, South China University of Technology, Guangzhou, China

- A neurally controlled bionic upper prosthetic limb with 6 actuated DOF is developed.
- A novel hybrid control strategy is designed for integrating EMG signals and visual signals to operate the prosthesis.
- The control method reduces the cognitive and operational burden of amputees.
- The prosthetic system aims to accommodate various types of disarticulations and patient needs.



Reach to grasp motions planning method

SaPMA4: Award Session IV

Session Chairs: Lea Steffen, FZI Research Center for Information Technology, Germany

Xinyu Zhang, Tsinghua University, China

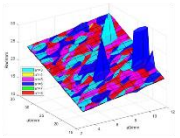
Empark Grand Hotel, No. 1 Conference Room, 14:00 - 15:30, Saturday, July 3, 2021

SaPMA4.1 **ID:153** 14:00 - 14:15

Kinematic Parameters Optimization of a Miniaturized Surgical Instrument Based on Dexterous Workspace Determination

Xin Zhi
Chongqing University-University of Cincinnati Joint Co-op Institute, Chongqing University, China
Weibang Bai, and Eric M. Yeatman
The Hamlyn Centre, Imperial College London, UK.

- Miniaturized instruments are highly needed for robot assisted less invasive surgery
- Kinematic design is challenging due to the contradictory needs of miniaturization and large dexterous workspace
- Proposes an approach based on dexterous workspace determination under necessary restraints
- Workspace determination is achieved by boundary determination and volume estimation



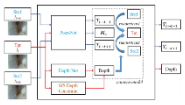
Parameter exploration based on dexterous workspace determination

SaPMA4.2 **ID:156** 14:15 - 14:30

Unsupervised Learning based Relative Localization for WCE in a Deformable Tubular Environment

Yangxin Xu[1], Keyu Li[1] and Max Q.-H. Meng[1,2]
[1] Department of Electronic Engineering, The Chinese University of Hong Kong, Hong Kong SAR, China
[2] Department of Electronic and Electrical Engineering, the Southern University of Science and Technology, Shenzhen, China

- A novel method based on unsupervised learning is proposed for relative localization of WCE in the real pig colon.
- The phenomenon of "fake far view" caused by the depth estimation error is investigated and is solved by a Shape from Shading (SfS) based depth constraint.
- Our proposed method is validated in a dataset created from several elastic ex-vivo pig colons with a higher localization accuracy than the baseline.



Unsupervised learning based visual odometry

SaPMA4.3 **ID:165** 14:30 - 14:45

Length-Constrained Mixed-Integer Convex Programming-based Generation of Tensegrity Structures

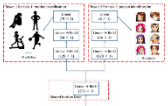
Ramil Khafizov, Sergei Savin
Institute of Robotics, Innopolis University, Russia

SaPMA4.4 **ID:176** 14:45 - 15:00

A Multi-task Learning Method for Human Motion Classification and Person Identification

Xinxing Chen[1], Kuangen Zhang[1,2], Yuquan Leng[1], Chenglong Fu[1]
[1] Department of Mechanical and Energy Engineering, Southern University of Science and Technology, China
[2] Department of Mechanical Engineering, University of British Columbia, Canada

- A multi-task learning method for human motion classification and person identification has been proposed.
- The proposed method can classify human activities and identify persons with 99.13% and 96.51% accuracy.
- Multi-task learning method can help enhance the performance of the benchmark single-task network.



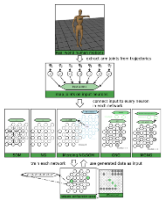
The proposed multi-task learning network structures

SaPMA4.5 **ID:177** 15:00 - 15:15

Reducing the Dimension of the C-Space with Self Organizing Neural Networks

Lea Steffen, Katharina Glueck, Stefan Ulbrich, Arne Roennau, Rüdiger Dillmann
FZI Research Center for Information Technology, Germany

- Algorithms for neural motion planning are often limited by the high dimensionality of the configuration space.
- To decrease the complexity, the search space is reduced by pruning superfluous neurons and synapses.
- Six different neural network models are evaluated for their reduction abilities.
- The Wavefront algorithm is used for path planning in the reduced C-Space

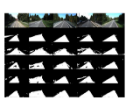


SaPMA4.6 **ID:42** 15:15 - 15:30

Multi-Modal Attention Guided Real-Time Lane Detection

Xinyu Zhang, Yan Gong, Zhiwei Li, Xuan Liu, Shuyue Pan and Jun Li
School of Vehicle and Mobility, Tsinghua University, China

- Proposing an effective real-time lane detection model with applying multi-frame inputs
- Proposing a new fusion strategy to compensate for the limitations of single-modal detection
- Introducing an attention mechanism for multimodal fusion to balance feature and capture significant areas



Row 2: ground truth. Row 6:Our method.

SaPMR1: Regular Session (Modeling and Optimization)

Session Chairs: Ziwei Zhang, Chongqing University, China

Yinghong Yu, Chongqing University, China

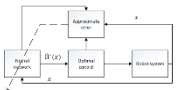
Empark Grand Hotel, Banquet Hall 3, 15:45 - 18:15, Saturday, July 4, 2021

SaPMR1.1 **ID:114** 15:45 - 16:00

Neural Network-Based Optimal Control of a Lower-limb Exoskeleton Robot

Pengbo Huang and Qinjian Li
The Department of Automation, University of Science and Technology of china, Hefei,China
Wang Yuan
The Institute of Advanced Technology, University of Science and Technology of china, Hefei,China
Ying Feng
The College of Automation Science and Engineering,South China University of Technology, Guangzhou,China

- We build the modeling of the exoskeleton robot
- The neural network is used to approximate the cost function
- An optimal controller is designed for the lower-limb exoskeleton robot



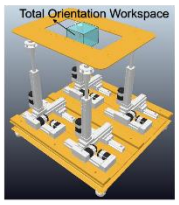
Overview of the control

SaPMR1.2 **ID:24** 16:00 - 16:15

Analysis of the Total Orientation Workspace of a Type of n-PPPS Parallel Manipulator

Zhaoyang Liu, Junfeng fan, Zhe Wang and Fengshui Jing*
Institute of Automation, Chinese Academy of Sciences, China
School of Artificial Intelligence, University of Chinese Academy of Sciences, China

- Reduce the solving process from a 6D space optimization to a 3D space one
- Prove the cuboid shape of the total orientation workspace (TOW) of the manipulator
- Relate the total orientation workspace (TOW) with mechanism parameters by the algorithm

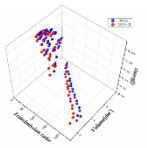


SaPMR1.3 **ID:32** 16:15 - 16:30

Multi-objective optimization of planetary reducer based on an improved genetic algorithm

Zheng Jianrui
The State Key Laboratory of Mechanical Transmission, Chongqing University, China
Wang Guangjian
The State Key Laboratory of Mechanical Transmission, Chongqing University, China

- An improved multi-objective genetic algorithm (IMOGA) is developed considering uneven competitive pressure.
- IMOGA is verified by six test functions and compared with classical NSGA-Ⅱ.
- IMOGA is applied to solve the planetary transmission optimization model.
- The results reveal the distribution of 3K- I type planetary reducer Pareto set.

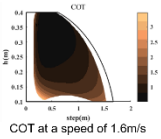


SaPMR1.4 **ID:35** 16:30 - 16:45

Gait Parameters Design Method of Trotting Gait Based On Energy Consumption

Xiangming Liu
College of Intelligence Science and Technology,
National University of Defense Technology , China

- Both swing period and support period are considered in energy consumption.
- Obtain the relationship between the height of torso centroid , step length and energy consumption.
- A gait parameter design method with minimum energy consumption of trotting gait is developed.



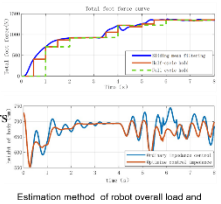
COT at a speed of 1.6m/s

SaPMR1.5 **ID:37** 16:45 - 17:00

Optimization Method of Impedance Control Parameters of Quadruped Robot Based on Dynamic Consistency

Cong Zhang, Jing Wang and Qing Wei
Department of automation, National University of Defense Technology, Hunan, China

- Proposes an impedance parameter optimization method based on the overall dynamic consistency of quadruped robot.
- Realized the automatic adjustment of the robot's expected foot force and impedance controller arameters based on the load.
- Introducing the strategy of ceiling control, which effectively reduces the fluctuation of the robot
- in motion.



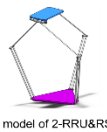
Estimation method of robot overall load and impedance control optimization effect

SaPMR1.6 **ID:86** 17:00 - 17:15

Multi-objective Parameters Optimization Design of a Novel 3-DOF Parallel Robot

Zhiyong Zhou and Bin Li
Department of Mechanical Engineering, Tianjin University of Technology, China
Qi Li and Yuan Zhang
Tianjin Key Laboratory of Aerospace Intelligent Equipment Technology, Tianjin Institute of Aerospace Mechanical and Electrical Equipment, China

- The 3-DOF 2-RRU&RSR parallel robot is taken as the target to carry out parametric modeling.
- Several important parameters of parallel robot are selected for multi parametric design.
- Multiple targets are combined into a total objective function through the weighting factor method.
- The multi-objective optimization design is carried out and a group of optimal parameters are obtained.



3D model of 2-RRU&RSR parallel mechanism

SaPMR1: Regular Session (Modeling and Optimization)

Session Chairs: Ziwei Zhang, Chongqing University, China

Yinghong Yu, Chongqing University, China

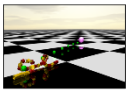
Empark Grand Hotel, Banquet Hall 3, 15:45 - 18:15, Saturday, July 4, 2021

SaPMR1.7 **ID:89** 17:15 - 17:30

Path Following for Snake Robot Using Crawler Gait Based on Path Integral Reinforcement Learning

Renpeng Wang and Wei Xi and Xian Guo and Yongchun Fang
College of Artificial Intelligence, Nankai University, China

- Path following problem is simplified to the optimal curvature sequence problem
- Rolling optimization technique is used to improve solution efficiency and real-time performance
- Path integral and model predictive ideas are integrated into the rolling optimization process



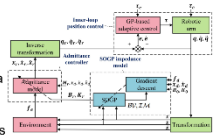
Simulation scene

SaPMR1.8 **ID:179** 17:30 - 17:45

Sparse Online Gaussian Process Impedance Learning for Multi-DoF Robotic Arms

Lixu Deng, Zhiwen Li, and Yongping Pan*
School of Computer Science and Engineering,
Sun Yat-sen University, China

- A novel gradient descent (GD)-SOGP impedance learning is proposed for variable admittance control.
- A high-fidelity mathematical model of a 7-DoF collaborative robot called Panda is applied for simulation studies.
- It is shown that the proposed GD-SOGP impedance learning outperforms the GD impedance learning in terms of impedance convergence.



The control architecture with GD-SOGP impedance learning

SaPMR1.9 **ID:182** 17:45 - 18:00

Model Predictive Control for Path Following of Autonomous Vehicle Considering Model Parameter Uncertainties

Ziwei Zhang, Ling Zheng, Yinong Li, Yinghong Yu and Xuqiang Qiao
College of Mechanical and Vehicle Engineering
Chongqing University, P.R. China

SaPMR1.10 **ID:184** 18:00 - 18:15

Motion planning based on steering obstacle avoidance under emergency conditions

Yinghong Yu, Tingqiong Cui, Yinong Li, Ling Zheng, and Ziwei Zhang
College of Mechanical and Vehicle Engineering
Chongqing University, P.R. China

SaPMR2: Regular Session (Wearable Robot)

Session Chairs: Yawu Wang, National University of Defense Technology, China

Jiaqi Xu, University of Science and Technology of China, China

Empark Grand Hotel, Banquet Hall 4, 15:45 - 18:15, Saturday, July 3, 2021

SaPMR2.1 **ID:14** 15:45 - 16:00

Scale Force Control of a Robot Bearing Augmentation Exoskeleton

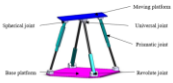
Lin Lang
College of Intelligence Science and Technology, National University of Defense Technology，China.

SaPMR2.2 **ID:15** 16:00 - 16:15

Multi-objective function optimization of 2-RPU&2-SPS parallel mechanism based on Adams

Chongshan Wang and Bin Li
Mechanical Engineering, Tianjin University of Technology, China
Jiaqi Zhu
Mechanical Engineering, Tianjin University of Technology, China

- Mechanism model and coordinate system
- Introduction to multi-objective optimization methods
- Parametric modeling and determine the objective function
- Multi-objective function establishment and Multi-parameter to multi-objective function optimization



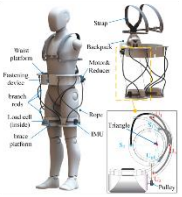
2-RPU&2-SPS parallel mechanism

SaPMR2.3 **ID:47** 16:15 - 16:30

Mechanical Design and Experimental verification of a Parallel Hip Exoskeleton with Virtual Rotation

Xiangyang Wang, Sheng Guo, Majun Song, Peiyi Wang
School of Mechanical, Electronic and Control Engineering
Beijing Jiaotong University
Beijing, China

- Parallel mechanism is adopted in the design of the exoskeleton structure
- Compensation for the kinematic mismatch between the biological and mechanical joints
- No parasitic force generated in soft tissues during assistance (compared with the soft exoskeleton)
- The whole system is lightweight and has high motion compatibility with human body



SaPMR2.4 **ID:49** 16:30 - 16:45

Design and Implement an Elastically Suspended Back Frame for Reducing the Burden of Carrier

Yuquan Leng, Xin Lin, Ranbao Deng, Kuangen Zhang and Chenglong Fu
Southern University of Science and Technology, China
Jing Chang and Lianxin Yang
Tsinghua University, China

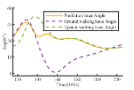
- Relationship between the elastic load and the parameters of the elastic system is analyzed;
- The prototype can bind loads of various shapes and the mass is 2.66 kg;
- The prototype reduces the amplitude of load by 30.2%;
- The mechanical work is reduced by 56.5% and the maximal power is also reduced by 66.1%.

SaPMR2.5 **ID:62** 16:45 - 17:00

Flat-Upstairs Gait Switching of Lower Limb Prosthesis via Gaussian Process and Improved Kalman Filter

Jin Zhang, Honglei An, Yongshan Huang, Qing Wei and Hongxu
Department of Automation, School of Intelligent Science, National University of Defense Technology, China

- A gait switching method of lower limb prosthesis is proposed
- The improved Kalman filter is used to filter the phase
- The expected joint angles are fitted by Gaussian process



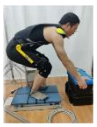
The trajectory of knee joint is predicted to transition from flat gait to the upper gait

SaPMR2.6 **ID:81** 17:00 - 17:15

Positive effect study of a passive waist-assistive exoskeleton on human muscle activity and stability

Xinshuai Huo, Zihan Luo, Muye Pang and Kui Xiang
Automation, Wuhan University of Technology, China

- A biomechanical model of human bending over is established to analyze the body movement mechanism.
- Use human muscle activation and center of pressure to evaluate the effect of exoskeleton in human bending motion .
- The kinematics parameters are used to assess the stability effect of the exoskeleton



SaPMR2: Regular Session (Wearable Robot)

Session Chairs: Jiaqi Xu, University of Science

and Technology of China, China

Yawu Wang, National University of Defense Technology, China

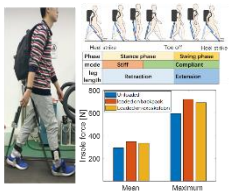
Empark Grand Hotel, Banquet Hall 4, 15:45 - 18:15, Saturday, July 3, 2021

SaPMR2.7 **ID:84** 17:15 - 17:30

Design and experimental evaluation of a non-anthropomorphic passive load-carrying exoskeleton

Zhijie Zhou, Wenbin Chen*, Hao Fu, Xiang Fang, Caihua Xiong
Institute of Robotics Research, State Key Lab of Digital Manufacturing Equipment and Technology,
Huazhong University of Science and Technology, China

- A non-anthropomorphic passive load-carrying exoskeleton is proposed.
- The simple and passive exoskeleton structure design bring the high robustness and flexibility.
- Simulation results show that the exoskeleton can reduce the foot pressure of the users.
- Standing and walking experiments verify that the exoskeleton can transfer the load to the ground.

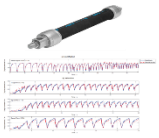


SaPMR2.8 **ID:91** 17:30 - 17:45

Control of a soft medical exoskeleton via a bio-inspired approach

Haozhen Chi, Hairong Su and Qinyuan Ren
College of Control Science and Engineering, Zhejiang University, China

- Stroke is becoming a widely concerned social problem requiring treatment;
- An antagonistic PAM-driven rehabilitation robotic device is developed for assistance;
- A knowledge-guided data-driven modeling approach is adopted for model identification;
- An adaptive feedforward–feedback control approach with CMAC and PID is presented to ensure the motion accuracy



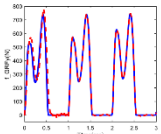
System identification results for PAM model

SaPMR2.9 **ID:93** 17:45 - 18:00

Ground Reaction Force Estimation in Robotic Prosthesis using Super-twisting Extended State observer

Yongshan Huang, HongXu Ma, Jin Zhang, Honglei An
College of Intelligence Science and Technology,
National University of Defense Technology,
Changsha, China

- Online GRFs estimation method based on super-twisting extended state observer (STESO) without using any load cell in robotic prosthesis.
- The GRFs estimation can converge to zero in a finite time due to the use of the globally integrated sliding mode surface and STESO.
- No need for an accurate mathematical model of GRFs. The stability and finite time convergence of the observer are rigorously proved and analyzed mathematically.



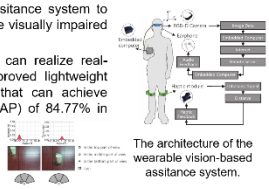
GRFs Estimation

SaPMR2.10 **ID:95** 18:00 - 18:15

Multi-functional Smart E-Glasses for Vision-Based Indoor Navigation

Jiaqi Xu, Haisheng Xia, Zhijun Li
the Department of Automation, University of Science and Technology of China, Hefei,China
Yueyue Liu
the College of Automation Science and Engineering, South China University of Technology, Guangzhou, China

- A wearable vision-based assitance system to improve the perception of the visually impaired in indoors.
- A navigation algorithm that can realize real-time path planning. An improved lightweight object detection algorithm that can achieve mean average precision (mAP) of 84.77% in the test set running at 39 fps.



The architecture of the wearable vision-based assitance system.

SaPMR3: Regular Session (Neural Network Modeling)

Session Chairs: Chenglin Xie, Sun Yat-sen University, China

Wenbin Zha, Anhui University of Technology, China

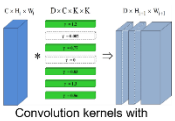
Empark Grand Hotel, International Hall, 15:45 - 17:00, Saturday, July 3, 2021

SaPMR3.1 **ID:59** 15:45 - 16:00

BNPrune: A Channel Level Pruning Method for Deep Neural Network used of Batch Normalization

Junqi Zhang, Qinghua Yu, Hui Peng and Hui Zhang
the College of Intelligence Science and Technology, National University of Defense Technology, China

- BNPrune makes use of the parameter in the BN layer.
- Every channel is assigned with a channel factor, which represents the importance of the channel.
- Improve L1 Regularization and make the parameter much sparser
- YOLOv4 model is trained on WiderFace dataset in Jetson TX2.



Convolution kernels with small scale factor values (dotted transparent boxes) will be trimmed.

SaPMR3.2 **ID:18** 16:00 - 16:15

Skeleton-based human activity analysis using deep neural networks with adaptive representation transformation

Jiahui Yu, Hongwei Gao, Qing Gao, Dalin Zhou, and Zhaojie Ju
School of Computing, University of Portsmouth, UK

- A new skeleton representation transformation method is proposed reduce the effect of perspective variations based on deep learning.

Schematic illustration of the proposed skeleton representation transformation method

SaPMR3.3 **ID:23** 16:15 - 16:30

Identification Modeling Based on RBFNN for an Aerial Inertially Stabilized Platform

Xiangyang Zhou, Weiqian Wang, and Yanjun Shi
School of Instrumentation and Optoelectronics Engineering, Beihang University, China

- The problem that inertially stabilized platform system model is difficult to establish is solved.
- An accurate identification modeling method based on RBFNN for the ISP system is proposed.
- The off-line/on-line composite identification method ensures the real-time of the dynamic model adjustment process.
- Experiments show that RBFNN system identification can accurately predict the actual output of ISP.

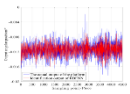


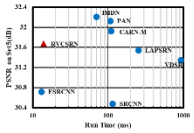
Figure 1. Experimental results of system identification

SaPMR3.4 **ID:41** 16:30 - 16:45

Deep Learning based Video Super-Resolution and its Application in Video Conferences

Yinyan Lin[1], Chaoyang Zou[2], Ying Feng[1], and Mingwei Liang[1]
1. School of Automation Science and Engineering
Key Laboratory of Autonomous Systems and Networked Control
South China University of Technology, Guangzhou, China.
2. Vision Institute, Central Research Institute, Guangzhou
Shiyuan Electronic Technology Company Limited, Guangzhou, China

- A novel real-time remote video communication super-resolution network (RVCSRN) is proposed .
- The proposed RVCSRN achieves a good balance between speed and restoration effect in video scenes.
- A remote video scene dataset (RVSet) is created to obtain a better super-resolution effect.



SaPMR3.5 **ID:88** 16:45 - 17:00

Deep FBSDE Controller for Attitude Control of Hypersonic Aircraft

Yujun Liu, Yutian Wang, Zeyan Zhuang and Xian Guo*
College of Artificial Intelligence, NanKai University, China

- Attitude control of Hypersonic Aircraft
- a system of Forward Backward Stochastic Differential Equations
- Deep Neural Networks, including FC-based architecture and LSTM-based architecture

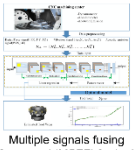
Fig. 1. LSTM network architecture

SaPMR3.6 **ID:90** 17:00 - 17:15

A Multiple Signals Fusing Framework for Tool Condition Monitoring based on Deep Learning

Yufeng Li, Xingquan Wang and Yan He*
State Key Lab of Mechanical Transmission, Chongqing University, China
Fei Ren
Shanghai Aerospace Equipment Manufacturing Plant Co., Ltd, Shanghai, China
Yuling Wang
School of Mechanical Engineering, Nanjing University of Science & Technology, China

- This paper proposes a multiple signals fusing framework for tool condition monitoring using Deep Learning
- Established a tool prediction model based on convolutional neural network
- A case study is demonstrated to validate the effectiveness of the proposed framework
- This work combines the advantages of various signals to improve tool condition monitoring performance



Multiple signals fusing framework(MSFF) for tool condition monitoring

SaPMR3: Regular Session (Neural Network Modeling)

Session Chairs: Chenglin Xie, Sun Yat-sen University, China

Wenbin Zha, Anhui University of Technology, China

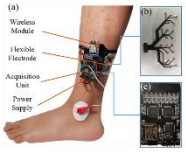
Empark Grand Hotel, International Hall, 15:45 - 17:00, Saturday, July 3, 2021

SaPMR3.7 **ID:141** 15:45 - 16:00

Foot Gesture Recognition with Flexible High-Density Device Based on Convolutional Neural Network

Chengyu Lin, Yuxuan Tang, Yong Zhou, Kuangen Zhang, Zixuan Fan, Yang Yang, Yuquan Leng and Chenglong Fu
Southern University of Science and Technology, China

- A skin deformation compatible, high-density, wireless wearable device is designed.
- Nine classes of foot gestures that intuitively map the movements of prosthesis are classified by the convolutional neural network classifiers.
- The average classification accuracy of 93.98% for nine classes of foot gestures.

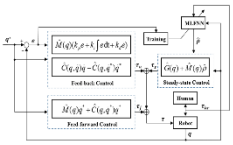


SaPMR3.8 **ID:168** 16:00 - 16:15

Triple-step Nonlinear Controller with MLFNN for a Lower Limb Rehabilitation Robot

Huanfeng Peng, Jie Zhou, Ting Xu, Jinwu Gao, and Rong Song
School of Biomedical Engineering, Sun Yat-sen University, China

- A triple-step nonlinear controller with a multi-layer feed-forward neural network is proposed for a LLRR.
- Experiments based on the triple-step nonlinear controller with and without MLFNN are carried out.
- Results show that the proposed controller can obtain higher tracking accuracy.



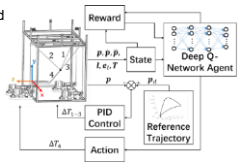
The triple-step nonlinear controller with MLFNN for the LLRR

SaPMR3.9 **ID:185** 16:15 - 16:30

Deep Reinforcement Learning Based Cable Tension Distribution Optimization for Cable-driven Rehabilitation Robot

Chenglin Xie, Jie Zhou, Rong Song, Ting Xu
School of Biomedical Engineering, Sun Yat-sen University, China

- Deep reinforcement learning is used to optimize cable tension distribution in a 3-DOF CDPR.
- Simulation experiment of end - effector tracking 3-dimensinal trajectory is performed with Matlab 2021a.
- Total cable tension and jerk value of tracking trajectory both decrease with increasing training time.



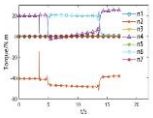
The overall control diagram

SaPMR3.10 **ID:187** 16:30 - 16:45

Manipulator Tracking Algorithm Based on Estimated Dynamics and Time-Varying Output Constraint State

Wenbin Zha and Xiangrong Xu
School of Mechanical Engineering, Anhui University of Technology, China
Aleksandar Rodic and Petar B. Petrovic
University of Belgrade, Serbia

- A neural network adaptive control method is proposed
- Effectively suppress chattering phenomenon when disturbed
- Solve the external interference caused by the impact problem of the 7-DOF manipulator
- RBF neural network fits the required features to reduce the difficulty of modeling



Tracking state of dragging experiment

SaPMR4: Regular Session (Intelligent Mechatronics)

Session Chairs: Chaoyue Chao, School of Electro-mechanical Engineering, China

Anqi Tan, Zhejiang University, China

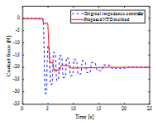
Empark Grand Hotel, No. 1 Conference Room, 15:45 - 18:15, Saturday, July 3, 2021

SaPMR4.1 **ID:19** 15:45 - 16:00

A Novel Force Oscillations Reduction Method Based on Nonlinear Tracking Differentiator for Robot Contact Transition Process

Xiangfei Li, Huan Zhao and Han Ding
State Key Laboratory of Digital Manufacturing Equipment and Technology , Huazhong University of Science and Technology, P. R. China

- This paper proposes a novel nonlinear tracking differentiator-based force oscillations reduction method
- The proposed method acts in a feed -forward style
- The proposed method can effectively reduce the force oscillations
- The effectiveness of the proposed method is verified by the simulations and experiments



Comparison of the contact force

SaPMR4.2 **ID:31** 16:00 - 16:15

A novel design of a contractible, tubular continuum manipulator

Zhiguang Xing, Pengyuan Wang and Jianwen Zhao
Mechanical Engineering Harbin Institute of Technology, Weihai, China
Guofeng Cao
Heilongjiang College of Business and Technology, China
Yuqiang Liu and Zongbo He
Beijing Institute of Spacecraft System Engineering, China

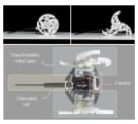
- Design of contractile continuum manipulator body
- Mechanical design of the actuation
- Simple demos of motion control

SaPMR4.3 **ID:44** 16:15 - 16:30

A Wheel-legged Mobile Robot with Adjustable Body Length for Rescue and Search

Long Bai, Xingyu Li, Yuanxi Sun and Xiaohong Chen
College of Mechanical and Vehicle Engineering , Chongqing University, China
Jia Zheng
College of Advanced Manufacturing Engineering, Chongqing University of Posts and Telecommunications , China

- This LDR-2 robot has deformable wheels and a retractable tail to adapt to different terrains.
- The article analyzes the influence between the robot's length and the stability.
- The control system can change the motion state of the robot according to different obstacles.
- Obstacle -crossing experiment proves the improvement of the robot's obstacle -crossing performance.



Structure of the LDR-2 robot

SaPMR4.4 **ID:57** 16:30 - 16:45

Research and Application of Rule-driven Configurable Design Method for Mechanical Products

Binyang Wang , Department of Mechanical Engineering, Chongqing University , Chongqing,China(phone:86 -17740240701;email:BY980126@mail.ustc.edu.cn).
Yuchuan Song , Department of Mechanical Engineering, Chongqing University, Chongqing, China (phone: 86 -13508366695; e-mail: syc@cqu.edu.cn).
Haoyin Zhang , Department of Mechanical Engineering, Chongqing University, Chongqing, China(phone:86 -15282813998;e-mail:haoyin_zhang@163.com).
Jiang Wu, Department of Mechanical Engineering, Chongqing University, Chongqing, China(phone:86-13330266521;e-mail:715727987@qq.com)

- Abstract— In order to solve the problems of complicated design process, insufficient optimization of design parameters and reuse of design knowledge during traditional mechanical product detailed design process, this paper proposes a rule-driven product configuration design method. Traditional mechanical product design process is divided into a number of design nodes and partially complex functions of traditional design process are defined in nodes .Design nodes are configured and connected after forming rule-driven nodes ,which sharply simplifies the configuration process of traditional design process and can realize the optimization of design parameters. The basic database that adapt to the design node is developed and the design knowledge is integrated into the basic database and node rules, which improves the configurability of the design process and better supports the parameter optimization of the design process and reuse of design knowledge. Finally, the system software is developed and the design process of Marine diesel turbocharger is taken as an example to verify the effectiveness of the method

SaPMR4.5 **ID:61** 16:45 - 17:00

Design and Development of a Novel 3-DOF Parallel Robotic Polishing End-effector

Xiaozhi Zhang and Zhongtao Fu
School of Mechanical and Electrical Engineering, Wuhan Institute of Technology, Wuhan, Hubei, China
Guangwei Wang
School of Mechanical Engineering, Guizhou University, Guiyang, Guizhou, China

- The robot Motoman MH180 to obtain large travel range of polishing operation.
- The end-effector with strain gauges conducts an closed-loop control for polishing process.
- The 3-DOF parallel decoupling flexure mechanism provides a complaint contact environment between the polishing tool head and workpiece surface to cut down the impact and backlash.

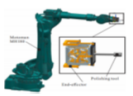


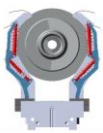
Fig. Demo of the polishing robot with end -effector.

SaPMR4.6 **ID:72** 17:00 - 17:15

Structure Design and Simulation Analysis of Under-Rank Endpicker of Hub Forging Robot

Yi Shen and Quanbing Zhang
College of Mechanical Engineering Jiangsu University of Science and Technology, China
Haipeng Miao
Suzhou Institute of Technology, Jiangsu University of Science and Technology, China

- An under-rank endpicker of wheel hub forging robot is designed, which can realize the adaptive envelope.
- The kinematic analysis of the end -picker proves the feasibility of its clamping motion.
- The clamping simulation of the endpicker is carried out to explore its clamping stability and adaptability.



Under-rank endpicker

SaPMR4: Regular Session (Intelligent Mechatronics)

Session Chairs: Chaoyue Chao, School of Electro-mechanical Engineering, China

Anqi Tan, Zhejiang University, China

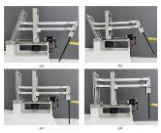
Empark Grand Hotel, No. 1 Conference Room, 15:45 - 18:15, Saturday, July 3, 2021

SaPMR4.7 **ID:76** 17:15 - 17:30

Kinematic Design of a 2DoFs Remote Center of Motion Mechanism for Minimally Invasive Surgical Robot

Guo Lianjie, Shi Hu and Liu Zhaoying
School of Mechanical Engineering, Xi'an Jiaotong University, China
Song Qichun
Department of Orthopaedics, the Second Affiliated Hospital of Xi'an Jiaotong University, China

- A mechanism that can realize pitch and translate motion of the surgical tool.
- The end of the MIS manipulator is lighter and smaller .
- the possibility of the interference between the manipulator and the patients' body is reduced.

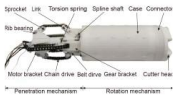


SaPMR4.8 **ID:77** 17:30 - 17:45

Mechanism Design of An Extraterrestrial Regolith-boring Robot

Yinliang Zhang, Hongyu Wei, Tao Zhang, Haifei Zhu and Yisheng Guan
School of Electro-mechanical Engineering, Guangdong University of Technology, China
Xilun Ding
School of Mechanical Engineering and Automation, Beihang University, China
Xuyan Hou
School of Mechatronics Engineering, Harbin Institute of Technology, China

- A planetary regolith boring robot with two degrees of freedom
- Rotation mechanism is inspired by Tunnel Boring Machine to improve the adaptability of regolith with different strengths
- Penetration mechanism makes the robot move along the borehole and automatically adapt to the borehole diameter
- The robot transports cuttings from its interior through a pneumatic system



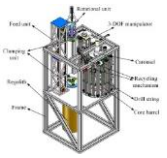
Prototype of the planetary regolith-boring robot

SaPMR4.9 **ID:78** 17:45 - 18:00

Mechanism design of a multi-functional drilling robot to sample seafloor sediments in marine investigation

Chaoyue Chao, Hongyu Wei, Bin Wang, Bing Wang, Yinliang Zhang, Zhixiao Yao, Tao Zhang, Haifei Zhu and Yisheng Guan
School of Electro-mechanical Engineering, Guangdong University of Technology, China
Xilun Ding
School of Mechanical Engineering and Automation, Beihang University, China

- A multi-functional drilling robot to sample seafloor sediments
- The mechanism is mainly composed of three parts: penetration and rotation mechanism, drill pipe manipulation mechanism and core sample conveyance mechanism
- The three mechanisms cooperate with each other for sampling seafloor sediments in complex seafloor environment



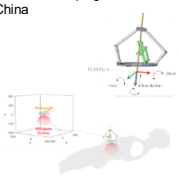
Three-dimensional design of seafloor-sediment drilling robot

SaPMR4.10 **ID:83** 18:00 - 18:15

Design Optimization of a Mechanically Constrained Re-Localizable Remote-Center-of-Motion

Anqi Tan, Shenwei Chen, Hanyu Gan, Liangjing Yang,
Zhejiang University/University of Illinois at Urbana -Champaign Institute, Zhejiang University, China

- Aim: Optimize the design of a mechanically constrained RCM Mechanism
- Approach: Establish optimal design requirements for MIS through kinematics modeling and workspace analysis
- Contribution: Re-localizable RCM point for a wider range of procedures; facilitation of the actuator placement at mechanism base



Tracking profiles during tool-cell interaction

Sunday
July 4, 2021

14:00 - 15:30	Regular Session SuPMR1: Adaptive Control	Banquet Hall 3
	Regular Session SuPMR2: Bionic Robotics	Banquet Hall 4
	Regular Session SuPMR3: Dynamics and Control	International Hall
	Regular Session SuPMR4: Imaging and Sensing	No. 1 Conference Room
15:45 - 18:15	Regular Session SuPMR5: Intelligent Learning and Control	Banquet Hall 3
	Regular Session SuPMR6: Locomotion Control	Banquet Hall 4
	Regular Session SuPMR7: Control System Modeling	International Hall
	Regular Session SuPMR8: Locomotion Control	No. 1 Conference Room

SuPMR1: Regular Session (Adaptive Control)

Session Chairs: Jie Gao, University of Chinese Academy of Sciences, China

Xuqiang Qiao, Chongqing University, China

Empark Grand Hotel, Banquet Hall 3, 14:00 - 15:30, Sunday, July 4, 2021

SuPMR1.1 **ID:27** 14:00 - 14:15

Design of the Self-adaptive Robot Finger Triggered by Light Pression with Cooperative Assistant

He Zhao and Weiguo Li
Dept. of Mechanical Engineering, Inner Mongolia University of Technology, Hohhot,China
Wenzeng Zhang
Dept. of Mechanical Engineering, Tsinghua University, Beijing, China

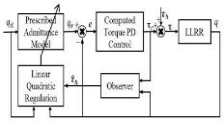
- An electronic trigger assisted coupled self-adaptive finger is proposed. The trigger threshold of the self-adaptive phalange is small, that is, the proximal phalange can trigger the grasping action of the self-adaptive finger segment to the object without exerting a large squeezing force on the object.In the meantime, the end of figer grasping force is stable. The problem that the grasping force of the self-adaptive finger segment of the traditional mechanical finger is too small relative to the proximal phalanx is solved. LPCA finger can realize the coupled and self-adaptive grasping mode, which has a wider range of applications.

SuPMR1.2 **ID:79** 14:15 - 14:30

Adaptive Admittance Control based on linear quadratic regulation optimization technique for a Lower Limb Rehabilitation Robot

Renyu Yang, Jie Zhou, and Rong Song,
School of biomedical engineering Sun Yat-sen University, China

- an adaptive admittance control based on LQR was designed to regulate parameters.
- The control law of actuator torque is designed based on the proposed.
- Simulations of passive gait trajectory tracking tasks and the active trajectory tracking task demonstrated the feasibility of this new control method.



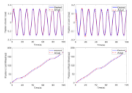
The proposed control framework

SuPMR1.3 **ID:100** 14:30 - 14:45

Adaptive Dynamic Surface Control of Mobile Manipulators Driven by Series Elastic Actuators

Xiaoqian Ren, Zhijun Li and Hongxuan Liu
Department of Automation,
University of Science and Technology of China, China
Yueyue Liu
College of Automation Science and Engineering,
South China University of Technology, China

- A nonholonomic constrained wheeled mobile manipulator with 7-DOF redundant manipulator s is developed
- Whole body model for mobile manipulator.
- An adaptive mechanism for compensating of the discontinuous friction.
- Adaptive dynamic surface backstepping control to solve uncertain dynamics.



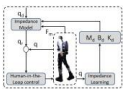
Control effect of two arm joints and wheels

SuPMR1.4 **ID:119** 14:45 - 15:00

Iterative Learning Control of Impedance Parameters for a Soft Exosuit

Xiang Li, Qinjian Li, Haisheng Xia and Zhijun Li
The Department of Automation, University of Science and Technology of china, Hefei,China
Ying Feng
The College of Automation Science and Engineering,South China University of Technology, Guangzhou,China

- Considering the ankle as a impedance model and an impedance learning method is proposed to adapt to different wearers.
- Two -loop control framework is developed for a soft exosuit.
- It is a practically applicable solution for soft exosuits in application scenarios with human - in-the-loop interaction, such as physical training and rehabilitation.



Overview of the framwork

SuPMR1.5 **ID:131** 15:00 - 15:15

Adaptive Event-triggered Tracking Control for A Manipulator Based on Dynamic Neural Network

Jie Gao and Hong Qiao
The State Key Laboratory of Management
Control for Complex Systems, University of Chinese Academy of Sciences, China
Xiaodong Zhang
The Beijing Key Laboratory of Intelligent Space Robotic Systems Technology and Applications, Beijing
Institute of Spacecraft System Engineering, China

- The ESDNN and observer are introduced to estimate the unmodeled dynamics and disturbances
- An event-triggered mechanism is proposed for the signal communication in the C -A channel
- The possible control gain and coefficients for the feasibility of this method are derived
- The method is verified on the 2 -DOF manipulator

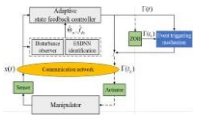


Figure 1. Control block diagram of the proposed method: doted -line indicates the aperiodic data transmission.

SuPMR1.6 **ID:183** 15:15 - 15:30

Vehicle States of Naturalistic Driving Data Based on Adaptive Optimization Gaussian Process Regression*

Xuqiang Qiao, Yinong Li, Ling Zheng, Zhida Zhang, Wei Yang
College of Mechanical and Vehicle Engineering
Chongqing University, P.R. China

SuPMR2: Regular Session (Bionic Robotics)

Session Chairs: Jianbo Yuan, University of Science and Technology of China, China

Amir Khan, Shandong University, China

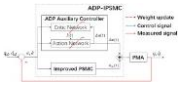
Empark Grand Hotel, Banquet Hall 4, 14:00 - 15:30, Sunday, July 4, 2021

SuPMR2.1 **ID:105** 14:00 - 14:15

Improved Proxy-based Sliding Mode Control Integrated Adaptive Dynamic Programming For Pneumatic Muscle Actuators

Zengqi Peng and Jian Huang
School of Artificial Intelligence and Automation ,
Huazhong University of Science and Technology , China

- An auxiliary control scheme is proposed for a class of pneumatic artificial muscles
- IPSMC is the main controller and ADP provide the auxiliary control signal
- The Lyapunov theorem is used to prove the stability of the proposed control strategy
- The maximum tracking error of ADP -IPSMC is less than half of that of other methods



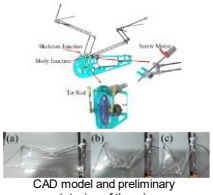
Schematic diagram of the proposed control strategy

SuPMR2.2 **ID:28** 14:15 - 14:30

Foldable Wings Improve Energy Efficiency of Bio-Inspired Flapping-Wing Robot

Yi Gong, Zongping Yang, Sichen Wang, Jintao Zhu, Tianshuo Huang, and Jun Zhang
School of Instrument Science and Engineering ,
Southeast University, China

- A design of foldable wing structure to improve energy efficiency is proposed
- A preliminary physical model was proposed to verify the feasibility of the structure
- The flapping process and folding process was driven by different motors
- More degrees of freedom achieve better flight maneuvers compared to the previous model



CAD model and preliminary prototyping of the wings

SuPMR2.3 **ID:68** 14:30 - 14:45

Influence of Gait Trajectory and Parameters on Energy Consumption of Hexapod Robot

Yuanxi Sun, Jingyang Zhan, Long Bai and Xiaohong Chen
College of Mechanical and Vehicle Engineering, Chongqing University , China
Jia Zheng
College of Advanced Manufacturing Engineering, Chongqing University of Posts and Telecommunications, China
Wenbo Duan
Xi'an Institute of Applied Optics , China

- The dynamic model of the flat ground and robot's energy consumption model are established.
- Polynomial curve, cosine curve, trapezoidal velocity curve and optimization curve are planned.
- The influence of gait trajectory and parameters on energy consumption of hexapod robot are discussed.

Hexapod robot prototype

SuPMR2.4 **ID:69** 14:45 - 15:00

Amphibious Robot with a Novel Composite Propulsion Mechanism

Long Bai, Gongzhi Dou, Yuanxi Sun and Xiaohong Chen
College of Mechanical and Vehicle Engineering , Chongqing University, China
Jia Zheng
College of Advanced Manufacturing Engineering, Chongqing University of Posts and Telecommunications , China
Wenbo Duan
Xi'an Institute of Applied Optics, China

- A novel propulsion mechanism based on the combination of curved-legged and webbed is proposed.
- The amphibious robot has excellent complex terrain trafficability and amphibious movement performance.
- A variety of experimental studies have proved the effectiveness of the propulsion mechanism.

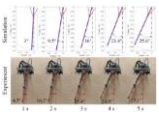
Amphibious Robot

SuPMR2.5 **ID:117** 15:00 - 15:15

Musculoskeletal robot with motor driven artificial muscle

Jianbo Yuan, Yaxiong Wu
School of Mechanical Engineering, University of Science and Technology, China
Boxing Wang, Hong Qiao
Institute of Automation, Chinese Academy of Sciences, China

- A musculoskeletal robot of two muscles and a single joint.
- A new artificial muscle module of motor drive and cord traction.
- A muscle control method is proposed with feedforward friction compensation for model errors
- Various experiments are carried out to evaluate the basic performance of the proposed musculoskeletal robot and the controller.



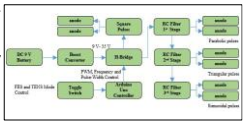
Experiment of musculoskeletal robot with two muscles and single joints

SuPMR2.6 **ID:22** 15:15 - 15:30

IEEE ARM 2021
Integrated Design of Functional Electrical Stimulator and Transcutaneous Electrical Nerve Stimulator on single protype.

Amir Khan and Ke Li
Department of Biomedical engineering, Motor Control and Rehabilitation , Shandong University, China
Na Wei
Department of Geriatrics, Qilu Hospital, Shandong University, China

- Novel Design of dual mood stimulator for stimulation on a single prototype.
- Control the parameters i.e. Operation mode, stimulation parameters (voltage, frequency, pulse width, and signal waveform).
- Boost converter control voltage and Arduino Uno microcontroller control frequency and pulse width.
- H-bridge generate control square wave and filters produce multiple stimulation waveforms.



Prototype overview

SuPMR3: Regular Session (Dynamics and Control)

Session Chairs: Jiakang Zhou, Northwestern Polytechnical University

Zuojun Zhu, Anhui University of Technology, China

Empark Grand Hotel, International Hall, 14:00 - 15:30, Sunday, July 4, 2021

SuPMR3.1 **ID:103** 14:00 - 14:15

Review of Bilateral Teleoperation Control Strategies with Soft Environment

Yaru Deng, Yushan Tang, Bo Yang*, Wenfeng Zheng and Shan Liu
School of Automation, University of Electronic Science and Technology of China, China
Chao Liu
Department of Robotics, LIRMM -CNRS, Montpellier, France.

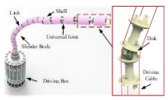
- Define the soft environment as linear elastic environment and nonlinear complex soft environment.
- Control strategies and structures of bilateral teleoperation with soft environment are classified and explained.
- Main applications of bilateral teleoperation with soft environment are discussed.
- Current challenges and future perspectives of bilateral teleoperation with soft environment are discussed.

SuPMR3.2 **ID:172** 14:15 - 14:30

Configuration and Driving Force Analysis of a Cable-Driven Hyper-Redundant Manipulator

Fengxu Wang , Han Yuan and Wenfu Xu*
The School of Mechanical Engineering and Automation , Harbin Institute of Technology, China
Jianqing Peng
The School of Intelligent Systems Engineering, Sun Yat-sen University, China
Bin Liang
The Shenzhen International Graduate School, Tsinghua University , China

- Slender body and flexible movement
- The configuration of the driving cable
- The relationship between cable position, driving force, external force and joint angles



The cable-driven hyper-redundant manipulator

SuPMR3.3 **ID:150** 14:30 - 14:45

An integrated control method of CNC machine tool assembly process based on fuzzy clustering

Yan Ran and Teng Zhang
College of Mechanical and Vehicle Engineering , Chongqing University , China
Teng zhang
College of Mechanical and Vehicle Engineering , Chongqing University , China

This paper propose a method to control three indexes focus on assembly process:

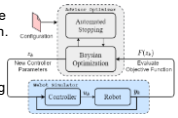
- Using "Function-Motion-Action"decomposition method to decompose CNC machine tool
- Evaluate quality loss through mass entropy method.
- Using fuzzy clustering method to find out control point of specific process, and propose corresponding control measures
- Actually ,this method can be used for whose assembly processes quality control focus on multiple target,therefore, it has reference significance for quality control and assembly method design.

SuPMR3.4 **ID:178** 14:45 - 15:00

Height Control and Optimal Torque Planning for Jumping with Wheeled-Bipedal Robots

Yulun Zhuang Yuan Xu Binxin Huang
Mandan Chao Guowei Shi Xin Yang
Mechanical and Energy Engineering, SUSTech, China
Kuangen Zhang Chenglong Fu
Mechanical and Energy Engineering, SUSTech, China

- Design an accurate controller based on torque planning and energy consumption optimization.
- Propose the W-JBD model for feedforward jumping control.
- Propose the BOTP method to optimize jumping for model with ambiguity.
- Propose a joint optimization framework to obtain the optimal control sequence of torque and velocity.



The simulation-based joint optimization framework

SuPMR3.5 **ID:154** 15:00 - 15:15

Real-time Interaction of a 7-DOF robot for teleoperated ultrasonic scanning

Jiakang Zhou, Bin Gao, Boyang Xue, Qinghua Huang*
School of Mechanical Engineering, and Center for Optical Imagery Analysis and Learning (OPTMAL), Northwestern Polytechnical University

- real-time position tracking is employed to guide the scanning robot following a trajectory captured by data glove dynamically.
- it can improve the sense of control, making the remote operator control the probe intuitively.

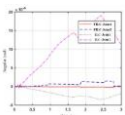
perform an ultrasonic acquisition process within a remote data glove

SuPMR3.6 **ID:188** 15:15 - 15:30

Research on Fuzzy Adaptive and PD-Type Iterative Learning Control for Robot Manipulator

Zuojun Zhu ,Xiangrong Xu and Yongfei Zhu
School of Mechanical Engineering, Anhui University of Technology, China
Aleksandar Rodic and Petar B. Petrovic
University of Belgrade, Serbia

- Presents a fuzzy self-adaptive PD-type iterative learning control method
- The Fuzzy control rules are written by using the Fuzzy toolbox
- Using the fuzzy controller to modify PD parameters in real-time to improve the adaptability



Tracking error of joint angular

SuPMR4: Regular Session (Imaging and Sensing)

Session Chairs: Yu Zhao, Nankai University, China

Shanshan Hu, Anhui University of Technology, China

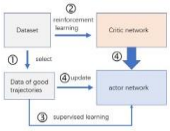
Empark Grand Hotel, No. 1 Conference Room, 14:00 - 15:30, Sunday, July 4, 2021

SuPMR4.1 **ID:40** 14:00 - 14:15

Learning to Predict Action Based on B-ultrasound Image Information

Yiwen Chen, Chenguang Yang and Shilu Dai
Automation Science and Engineering, South China University of Technology, China
Miao Li
Power and Mechanical Engineering, Wuhan University, China

- In our work, the strategy of how to move the probe to detect the kidney is studied.
- We leverage the data learning to realize the guidance of the B-ultrasound probe action.
- An actor-critic reinforcement learning algorithm that uses asymmetrical data is proposed.



SuPMR4.2 **ID:164** 14:15 - 14:30

Event-based Object Detection with Lightweight Spatial Attention Mechanism

Zichen Liang, Guang Chen and Peigen Liu
School of Automotive Studies, Tongji University, China
Zhijun Li
Department of Automation, University of Science and Technology China
Alois Knoll
Department of Informatics, Technical University of Munich Munich, Germany

- An event-based spatial attention mechanism is proposed to reduce the negative influence brought by irregular noise.
- A good combination of the event -encoding method and the one -stage detection method is provided.
- convolution neural network achieves a better performance than sparse convolution network.

Overview Architecture

SuPMR4.3 **ID:60** 14:30 - 14:45

Research on the Algorithm of Target Location in Aerial Images under a Large Inclination Angle

Yu Chen and Xinde Li
Guangdong intelligent robotics Institute , China
School of Automation, Southeast University, C hina
Shuzhi Sam Ge
Department of Electrical & Computer Engineering, National University of Singapore, Singapore
Institute for Future (IFF), Qingdao University, China

- To solve the problem of large positioning errors of aerial targets under large inclination angles
- Design a BP neural network to automatically calculate the high-accuracy positioning of the target
- Convert the pixel distance to the distance value in the longitude and latitude directions
- The average positioning error is about1m in aerial targets of oblique images

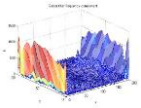
Flow chart of the target location algorithm

SuPMR4.4 **ID:189** 14:45 - 15:00

Solder Joint Inspection Using Imaginary Part of Gabor Features

Wu Hao and Xiangrong Xu
School of Mechanical Engineering, Anhui University of Technology, China
Aleksandar Rodic and Petar B. Petrovic
University of Belgrade, Serbia

- The RGB color solder joint image is transformed into HSI model space
- The image Gabor features is extracted
- A feature selection method based on principal component analysis is used
- The SVM classifier classified the solder joint into defect type in the following



the 3D energy of imaginary part Gabor features

SuPMR4.5 **ID:149** 15:00 - 15:15

A Study on Intrarenal Porous Segmentation of Endoscopic Images

Yu Zhao, Rui Li, Minghui Han, Gongping Chen, Yu Dai, Jianxun Zhang
College of Artificial Intelligence, Nankai University, China

- Focusing on the intrarenal endoscopic porous images, a data set using real surgery videos is produced.
- An SVM-based classification method is proposed to extract the keyframes into two types.
- The VGG16 network with strong mobility is used as the encoder of the segmentation model.
- Our improved U-Net model is experimentally validated on classified deep and shallow porous images.

SuPMR4.6 **ID:190** 15:15 - 15:30

A 3D Semantic Visual SLAM in Dynamic Scenes

Shanshan Hu, Dan Li* and Gujie Tang
School of Electrical Information and Engineering, Anhui University of Technology, China
Xiangrong Xu
School of Mechanical Engineering, Anhui University of Technology, China

- Combining with improved region growing algorithm, multi-view geometric to eliminate moving targets.
- SSD-MobileNetV2 combined with Super voxel segmentation based on color convexity algorithm to obtain 3D information.
- As shown in graph, construction of semantic 3D Octo-Map in dynamic scenes.

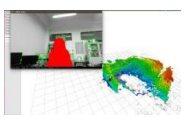


Figure Dense 3D Semantic Octo-Map in Lab Environment

SuPMR5: Regular Session (Intelligent Learning and Control)

Session Chairs: Binyou Wang, Chongqing University, China

Yan Meng, Institute of Automation, Chinese Academy of Sciences, China

Empark Grand Hotel, Banquet Hall 3, 15:45 - 17:00, Sunday, July 4, 2021

SuPMR5.1 **ID:45** 15:45 - 16:00

A Metadata based manufacturing resource registration approach in cloud manufacturing

Youling Chen
College of Mechanical and Vehicle Engineering, Chongqing University, China
Yue Liu
College of Mechanical and Vehicle Engineering, Chongqing University, China

- Research context is cloud manufacturing, and object is extrusion equipment manufacturing recourses.
- The target problem: the open registration method of manufacturing resources in cloud manufacturing.
- Proposed method: Metadata registration method
- Used Technology: Ontology, Metadata registration, Java.

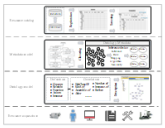


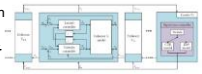
Fig.1 Metadata -based manufacturing resource registration framework

SuPMR5.2 **ID:51** 16:00 - 16:15

Distributed Cooperative Control of Vehicle Platoon Based on a Composite Safety Distance

Chao Fang, Jinyong Shangguan, Hao Li, Ming Yue*
School of Automotive Engineering, Dalian University of Technology, China

- A distance model combining the CTH and the IDP safety distance models is applied in the supervisor controller.
- A coordinated controller consisting of MPC based lateral controller and SMC-based velocity controller is presented
- Numerical simulation results validate the feasibility and effectiveness of the proposed method.



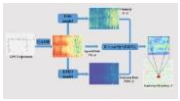
Distributed cooperative control strategy

SuPMR5.3 **ID:85** 16:15 - 16:30

An Estimating Traffic Emission Method of Road Network Based on Incomplete GPS Trajectories

Zhenyi Zhao,Yang Cao,Yu Kang,Zhenyi Xu,Lihong Pei,Binkun Liu
Automation, University of Science and Technology of China,China
Artificial Intelligence, Hefei Comprehensive National Science Center,China
Advanced Technology, University of Science and Technology of China,China

- To solve the inaccurate emission estimation caused by the incomplete traffic status:
- 1.The speed field is constructed by Gaussian Adaptive Smoothing Method using incomplete GPS trajectories;
- 2.The volume and emission rate are calculated by the Edie model and EMIT model;
- 3.Above variables are multiplied and accumulated to get the emission of the road.



Framework of estimating emission method

SuPMR5.4 **ID:97** 16:30 - 16:45

Reliability evaluation method for Meta-action unit based on the all fault modes

Zongyi Mu and Yan Ran and Genbao Zhang and Guangqi Ying
College of Mechanical Engineering, Chongqing University, P.R. China

- This is a reliability evaluation method based on all fault modes and running data of the Meta-action unit
- This reliability evaluation method not only needs less data, but also needs time cost.
- This reliability evaluation method can evaluate the Meta -action unit's reliability during the running process, which is more immediate than the traditional reliability evaluation method

Comparison

SuPMR5.5 **ID:98** 16:45 - 17:00

A Brain-inspired Decision-making Model for Spatio-temporal Pattern Recognition

Binyou Wang [1#], Bilan Tan [1#], Xiaolong Zou [2#], Xiaohan Lin [2], Changwei Huang [3], Si Wu[2], and Yuanyuan [1*]
1 School of Medicine, school of bioengineering, Chongqing University, Chongqing
2 School of Electronics Engineering and Computer Science, Peking University, Beijing
3 School of Computer, Electronics and Information, Guangxi University, Guangxi

- We propose a brain-inspired decision-making network for spatio -temporal pattern recognition.
- We analyze the mechanism and properties of the proposed model with using synthetic data.
- We demonstrate the potential application of the model to real -world problems.

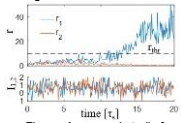


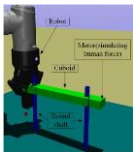
Figure. An example trail of discriminating two temporal sequences with slight different mean values.

SuPMR5.6 **ID:102** 17:00 - 17:15

Reinforcement Learning Based Variable Impedance Contrc for High Precision Human-robot Collaboration Tasks

Yan Meng, Jianhua Su, and Jiaxi Wu
Institute of Automation, Chinese Academy of Sciences, China

- A teach-less approach is proposed for high precision human-robot collaboration tasks.
- The framework of learning -based force control combines Deep RL techniques with impedance control.
- The model can be generalized to handle different situations and cooperate with different operators.



SuPMR5: Regular Session (Intelligent Learning and Control)

Session Chairs: Binyou Wang, Chongqing University, China

Yan Meng, Institute of Automation, Chinese Academy of Sciences, China

Empark Grand Hotel, Banquet Hall 3, 15:45 - 17:00, Sunday, July 4, 2021

SuPMR5.7 **ID:104** 15:45 - 16:00

Multi-Gait Recognition for a Soft Ankle Exoskeleton with Limited Sensors

Liang Ma, Yuquan Leng, Kuangen Zhang, Yuepeng Qian and Chenglong Fu
Southern University of Science and Technology, China

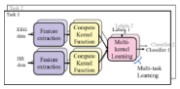
- A multi-gait recognition algorithm for a soft ankle exoskeleton with two IMUs mounted on foot.;
- The proposed algorithm can provide an and accurate automatic recognition result at the early beginning of each stance phase.
- The proposed algorithm can distinguish level walking, stair ascent/descent, and ramp ascent/descent with 99.0% success rates

SuPMR5.8 **ID:106** 16:00 - 16:15

Logistic Regression Based Multi-task, Multi-kernel Learning for Emotion Recognition

Xinrun He , Jian Huang and Zhigang Zeng
School of Artificial Intelligence and Automation,
Huazhong University of Science and Technology , China

- One channel Electroencephalogram (EEG) and Heart Rate (HR) were used for emotion recognition
- Recognition tasks in each dimension of Valence-Arousal emotion model were considered as multi-task
- Multi-kernel learning was used for data fusion, and the recognition accuracy increased by 10%



The proposed model for emotion recognition

SuPMR5.9 **ID: 121** 16:15 - 16:30

Object Detection of Surgical Instruments Based on YOLOv4

Yan Wang, Qiyuan Sun, Guodong Sun and Zhenzhong Liu
School of Mechanical Engineering, Tianjin University of Technology, China
Lin Gu
RIKEN AIP, The University of Tokyo, Japan

- Real-time convolutional neural network model based on YOLOv4 to detect surgical instruments during surgery.
- The object detection effect based on YOLOV4 is better than other methods.
- Yolov4 realizes the unification of high -speed and high-precision detection of surgical instruments.
- Compared with the previous version of YOLO, YOLOv4 can achieve more complex detection.

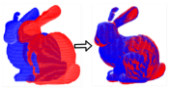
Surgical instrument detection results

SuPMR5.10 **ID:123** 16:30 - 16:45

An Improved ICP Algorithm for Point Cloud Registration

Guodong Sun , Yan Wang and Zhenzhong Liu
Mechanical Engineering, Tianjin University of Technology China
Lin Gu
RIKEN AIP, The University of Tokyo, Japan

- The FPFH algorithm is utilized as the initial registration method.
- The ISS algorithm is used to extract the key points.
- The k-d tree structure is used to accelerate the search for corresponding point pairs.
- Remove the wrong point pairs using distance constraint and cosine constraint of normal vector angle.



Registration Diagram

SuPMR6: Regular Session (Locomotion Control)

Session Chairs: Wu J., Institute of Automation, Chinese Academy of Sciences, China

Xiang Gao, Automation, Wuhan University of Technology, China

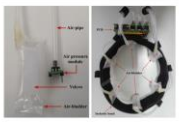
Empark Grand Hotel, Banquet Hall 4, 15:45 - 18:15, Sunday, July 4, 2021

SuPMR6.1 **ID:108** 15:45 - 16:00

Gait Phase Recognition Based on Air-pressure Mechanomyogram and Sensor Fusion

Enkai Wang, Jian Huang, Yuge Li, Yuqi Cui and Xiaolong Li
School of Artificial Intelligence and Automation,
Huazhong University of Science and Technology, China

- We designed a novel air-pressure mechanomyogram (PMMG) sensor and PMMG-based thighring which can be used to measure the thigh muscle activity.
- we are the first to recognize the gait phase by using PMMG sensors and the recognition accuracy reached 98.82%.
- We used five machine learning based sensor fusion algorithms to fuse data from multi-modal sensors and single-modal sensors. Experiments proved that the performance of former is better than latter.



The PMMG sensor and the PMMG-based thighring

SuPMR6.2 **ID: 113** 16:00 - 16:15

Design of a Portable Indoor Guide Robot for Blind People

Jiaxin Lai and Jianjun Yuan
Shanghai Robotics Institute, Shanghai University, China
Hanyue Lei
Robotics Institute, Shanghai Jiao Tong University, China

- The robot has the characteristics of simple structure, low cost, light weight, foldability and portability.
- The visually impaired people is guided by the robot through an elastic rope and a force sensor.
- Multiple sensors are installed on the robot to realize spatial obstacle avoidance.

SuPMR6.3 **ID:136** 16:15 - 16:30

Development of A Novel Dual-arm Robot via Modular Actuator

Weijun Wang, Jiangtao Hu, Xiaofeng Yang, Tian Xie, Chaoyang Ma
The 21st Research Institute of CETC, Shanghai
Wenjie Li
Beijing Microelectronics Technology Institute, Beijing

- A CAD model and the kinematic and dynamic analysis of the proposed robot
- A prototype of this robot is presented and the performance tests are presented
- A conclusion with future development perspectives

A Novel Dual-arm Robot

SuPMR6.4 **ID:33** 16:30 - 16:45

Tracking Control for a Robotic Manipulator under Constraints Violation during Operation and Unknown Initial Conditions

Yu Zhang, Yifan Wu, Linghuan Kong and Wei He
Department Name Institude of Aritificial Intelligence and the School of Automation and Electrical Engineering, University of Science and Technology Beijing, China
Yinsong Ma
School of Electronic and Information Engineering,
Beihang University, China

- Proposing a novel error shifting transformation.
- Addressing the issue of continuous repetitive constant output deferred constraints.
- The states are constrained within a preset time frame under any initial conditions.
- The output constraints can be violated during system operation.

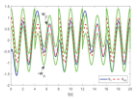


Fig.1 Constraint violation during operation and unknown initial condition

SuPMR6.5 **ID:36** 16:45 - 17:00

Motion Planning for Legged Robots via the Feasible Force Set

Jing Wang
College of Intelligence Science and Technology,
National University of Defense Technology,China

- Modeling the dynamics and kinematics of a single-legged robot.
- The concept of feasible force sets was introduced, determining the range of foot-end forces under different configurations of the single leg.
- During the motion of the robot with varying velocity, the desired motion is achieved by determining footholds through the set of feasible forces.

SuPMR6.6 **ID:39** 17:00 - 17:15

Gait Planning and Control of Hexapod Robot Based on Velocity Vector

Junfeng Xue, Jiehao Li, Zhihua Chen, Shoukun Wang, Junzheng Wang
State Key Laboratory of Intelligent Control and Decision of Complex Systems, School of Automation, Beijing Institute of Technology, Beijing 100081, China
Ruijun Ma
Department of Computer and Information Science, University of Macau, E11, Macau, Chin

- The gait planning and control are the main challenge for hexapod robots in unknown terrains, especially when the robot needs to turn. A gait planning and control method based on velocity vector is proposed in this paper for gait turning.
- The relationship between velocity vector and rotation center is established, and the algorithm flow of diagonal gait and turn gait based on velocity vector is designed.

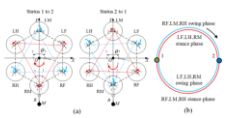


Fig.3. Diagonal gait based on velocity vector: (a) Diagonal gait; (b) State machine

SuPMR6: Regular Session (Locomotion Control)

Session Chairs: Wu J., Institute of Automation, Chinese Academy of Sciences, China

Xiang Gao, Automation, Wuhan University of Technology, China

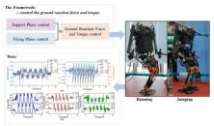
Empark Grand Hotel, Banquet Hall 4, 15:45 - 18:15, Sunday, July 4, 2021

SuPMR6.7 **ID:43** 17:15 - 17:30

A Unified Control Framework for High-Dynamic Motions of Biped Robots

Chencheng Dong, Yuanxi Zhang,
Huanzhong Chen and Qingqing Li
School of mechatronic Engineering, Beijing Institute of Technology, China.
Zhangguo Yu and Qiang Huang
Beijing Advanced Innovation Center for Intelligent Robotics and Systems,
Beijing Institute of Technology, China.
Xuechao Chen
Bionic Robot Mechanism, Perception and Control Laboratory, China.

- Instability result from considerable inertia force since the speed of the motions are high.
- Huge impact occurs after the flying phase.

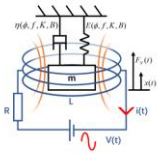


SuPMR6.8 **ID:48** 17:30 - 17:45

Working Properties of Compliant Actuators based on Magnetorheological Elastomer

Chongbin Li[1], Ying Feng [1], Hou-Pin Yoong [2], Mingwei Liang [1], Jiapeng Chen [1]
1. School of Automation Science and Engineering
Key Laboratory of Autonomous Systems and Networked Control
South China University of Technology, Guangzhou, China.
2. Faculty of Engineering, University Malaysia Sabah. Kota Kinabalu, Sabah, Malaysia.

- The working properties of a new compliant actuation construct utilizing liquid alloy conductors, and magnetorheological elastomers(MREs) are discussed.
- Details of the new compliant actuation construct are introduced, and the magnetorheological (MR) effect is analyzed.
- Simulation is conducted to show the output characteristics of the Magnetorheological Elastomer.



SuPMR6.9 **ID:80** 17:45 - 18:00

Learning Smooth and Omnidirectional Locomotion for Quadruped Robots

Wu J., Zhang D., Zhong S., Wang B., and Qiao H.
Institute of Automation, Chinese Academy of Sciences, China
Wang C.
School of Mechanical Engineering, USTB, China

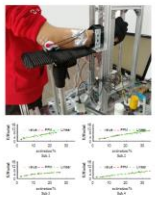
- By reinforcement learning, the quadruped robots learn smooth and omnidirectional locomotion.
- The transformation loss is proposed to improve the locomotion performance.
- The PD controller is integrated into the trained model to reduce the velocity following error.

SuPMR6.10 **ID:82** 18:00 - 18:15

Estimation of Dynamic Impedance of Human Wrist Joint in F/E with a Novel Instrument

Xiang Gao, Gang Xu, Muye Pang, Biwei Tang and Kui Xiang
Automation, Wuhan University of Technology, China

- A WriJIMI based on the principle of series elasticity is developed.
- State space estimation algorithm based on error prediction method is adopted to quantify dynamic impedance.
- The accuracy and reliability of the developed device are verified via experimental tests.
- Passive and active impedance of wrist joint is initially analyzed.



SuPMR7: Regular Session (Control System Modeling)

Session Chairs: Yuting Zhang, University of Macau, China

Yuwu Yao, Hefei University, China

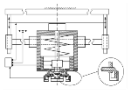
Empark Grand Hotel, International Hall, 15:45 - 17:00, Sunday, July 4, 2021

SuPMR7.1 **ID:9** 15:45 - 16:00

Structure Configuration of a Manipulator for Internal Bracing Grasping of the Fragile Thin-Walled Cylindrical Inner Wall Parts

Liangwen Wang[1], Shizhao Zhang[1] and Ruolan Wang[2]
[1]College of Mechanical and Electrical Engineering, Zhengzhou University of Light Industry, China
Yangguang Kong[1] , Xuling Liu[1] and Junlong Liu[1]
[2]College of International Education, Zhengzhou University of Light Industry, China

- The introduction of the overall structure of manipulator.
- Manipulator steady operation conditions and the restrictions of the cylinder driving force.
- Design and comparison of the fingers motion driving system.
- Morphology design of mechanical fingers.



The structure of manipulator system

SuPMR7.2 **ID:16** 16:00 - 16:15

Passive Hand Rehabilitation Training Through Robots: An Iterative Learning Control Approach

Long Cheng[1,2], Siyuan Liu[3], and Deyuan Meng[3]
1. State Key laboratory of Management and Control for Complex Systems, Institute of Automation, Chinese Academy of Sciences, China
2. School of Artificial Intelligence, University of Chinese Academy of Sciences
3. The Seventh Research Division, Beihang University

- Iterative learning controller equipped with the feedback mechanism for the passive training is developed.
- The asymptotic convergence and the monotonic convergence of the proposed controller are rigorously analyzed.
- The numerical simulations and physical experiments are performed to verify the effectiveness of the proposed controller.

SuPMR7.3 **ID:20** 16:15 - 16:30

Formation Simulation for Multi-point Array Based on Ultrasonic Standing Wave

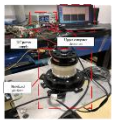
Yuanlong Sun, Huiyu Peng, Yan Jin, Shuyuan Ye, Zhili Long
School of Mechanical Engineering and Automation,Harbin Institute of Techonlogy(ShenZhen), China

SuPMR7.4 **ID:21** 16:30 - 16:45

Nonlinear dynamics decoupling control for a light and small inertially stabilized platform

Xiangyang Zhou and Xinping Dai
Instrumentation and Optoelectronics Engineering, Beihang University, China
Yating Li
Instrumentation and Optoelectronics Engineering, Beihang University, China

- A decoupling control method based on inverse system and model reference adaptive control (MRAC) is proposed.
- Decoupling controller based on the inverse system feedback linearization is established to linearize the ISP.
- The MRAC method is used to suppress the residual coupling disturbance.
- The effectiveness of the composite decoupling control method is proved by experiments.



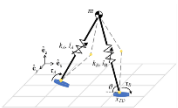
Experimental equipment and site

SuPMR7.5 **ID:46** 16:45 - 17:00

Bipedal Walking Based on Variable Spring-Loaded Inverted Pendulum Model with Finite-sized Foot

Sicheng Xie, Xinyu Li, Haoran Zhong, Chenghao Hu, and Liang Gao
School of Mechanical Science and Engineering, Huazhong University of Science and Technology, China

- Propose an improved SLIP model called **Variable Spring-Loaded Inverted Pendulum with Finite-sized Foot (VSLIP-FF)**
- Propose **a bio-inspired gait planning method** based on an adaptive leg stretching and contracting strategy
- Realize compliant walking based on the VSLIP-FF model to **step over discrete terrain**



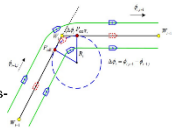
Improved VSLIP-FF model

SuPMR7.6 **ID:50** 17:00 - 17:15

Robust event-triggered formation control for underactuated ships under the practice constraint

Shang Liu and Guoqing Zhang and Bo Li and Xianku Zhang
Navigation College, Dalian Maritime University, China

- Formation control to achieve autonomy of underactuated ships
- Event-triggered control to economize the communication channel
- Intelligent guidance to program the waypoints-based reference route
- Robust neural control to reject the model uncertainty and the time-varying external disturbance



Control and guidance

SuPMR7: Regular Session (Control System Modeling)

Session Chairs: Yuting Zhang, University of Macau, China

Yuwu Yao, Hefei University, China

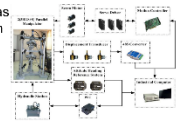
Empark Grand Hotel, International Hall, 15:45 - 17:00, Sunday, July 4, 2021

SuPMR7.7 **ID:127** 15:45 - 16:00

Dynamic parameter identification method for a 2(3HUS+S) parallel manipulator

Shibiao Chen, Gang Cheng and Xiangzhen Liu
School of Mechatronic Engineering,
China University of Mining and Technology, China

- A model for identifying dynamic parameters was established based on the matrix transformation principle.
- An identification strategy of the dynamic parameters was designed using disassembly measurement and system identification methods.
- A motion track under different conditions was designed to identify the dynamic parameters.



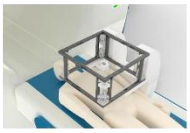
Experimental framework of parameter identification

SuPMR7.8 **ID:134** 16:00 - 16:15

The Design and Control of a CT-compatible Puncture Robot System based on Cable-driven

Haocheng Liu, Xingyi Huang, Jin Wang*, Jing Guo,
Shuting Cai and Xiaoming Xiong
Department of Automation, Guangdong University of Technology, China

- Cable-Driven construction
- 6 DOF robotic system
- CT-compatible mechanical structure design
- Mean linear positioning error: 0.5mm and Close-loop angle positioning error: 0.06°

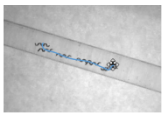


SuPMR7.9 **ID:138** 16:15 - 16:30

Design and Testing of a Rotational Magnetic System for Driving Helical Swimmer in Circular Duct Environment

Yuting Zhang, Zehao Wu, Ziqiang Chi, and Qingsong Xu
Department of Electromechanical Engineering, Faculty of Science and Technology, University of Macau, Macau, China

- A rotational magnetic system is designed for driving helical swimmer running in circular duct environment
- A small-scaled helical swimmer with length less than 7 mm is driven to mimic the operation in blood vessel
- Experimental results verify the effectiveness of the proposed system for precise operation under visual servo control



SuPMR7.10 **ID:142** 16:30 - 16:45

Output-Reference Finite-Time Bounded Tracking Control of Linear Systems with Disturbance Generated by an Exosystem

Yuwu Yao[1], Xiaohui Yan[1], Huangfeng Chan[1] and Yuhua Wu[1]
[1]Key Laboratory of Applied Mathematics and Mechanism of Artificial Intelligence, Hefei University,Hefei, China

- In present paper the finite-time bounded tracking control of discrete-time systems with external disturbance is considered.
- We constructed a new system so that the problem can be transformed into finite-time boundedness(FTB) problem of the output vector error system.
- Based on FTB of the constructed system, a tracking controller for the original system is designed to ensure that the system is finite-time bounded tracking of the reference signal.

SuPMR8: Regular Session (Locomotion Control)

Session Chairs: Wen Qi, University of Science and Technology of China, China
Tao Zhang, University of Science and Technology of china, China
Empark Grand Hotel, No. 1 Conference Room, 15:45 - 17:00, Sunday, July 4, 2021

SuPMR8.1 **ID:111** 15:45 - 16:00

A Terrain-based Gait Self-adjusting Planning for Powered Prostheses

Zong Yao and Hang Su
the Department of Automation, University of Science and Technology of China, Hefei,China
Junjun Li
the College of Automation Science and Engineering, South China University of Technology, Guangzhou, China

- The powered prosthesis is equipped with cameras.
- A VGGNet model is designed to recognize the current terrain.
- The recognized terrain is used to generate the motion trajectory of the prosthesis.

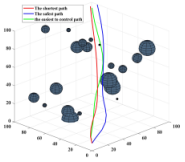
Powered prosthesis with camera

SuPMR8.2 **ID:132** 16:00 - 16:15

A Three-Dimensional Path Planning Method of Autonomous Burrowing Robot for Lunar Subsurface Exploration

Yangyi Liu, Zihao Yuan and Yangping Li
University of Chinese Academy of Sciences, China
Haifeng Zhao*
Space Utilization Technology and Engineering Center for Space Utilization, University of Chinese Academy of Sciences, China

- Built a 3D lunar subsurface model with randomly distributed rocky geo-objects
- Developed an improved Rapid-exploration Random Tree algorithm for forward movement
- Established a multi-objective optimization strategy to generate the optimal trajectory of a self-locomotion robot



Plots of optimal paths

SuPMR8.3 **ID:144** 16:15 - 16:30

Critic PI2: Master Continuous Planning via Policy Improvement with Path Integrals and Deep Actor-Critic Reinforcement Learning

He Ba and Jiajun Fan and Xian Guo
College of Artificial Intelligence, Nankai University, China
Jianye Hao
Noah's Ark Lab, Huawei Technologies, China

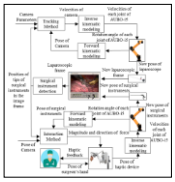
- Present a novel model-based reinforcement learning framework.
- Introducing a dynamic network to reduce estimation error
- Using a value network to calculate a trajectory's reward with less time consumption and low variance
- Combining the superiority of model-free reinforcement learning and model-based reinforcement learning to improve sample efficiency

SuPMR8.4 **ID:159** 16:30 - 16:45

Haptic Feedback Based Laparoscope Movement Perception Method for Autonomous Surgical Instruments Tracking in Robot-Assisted Minimally Invasive Surgery

Jin Fang, Xiaojian Li*, Ling Li, Jinyu Feng, Youtong Tantai
School of Management, Hefei University of Technology, Hefei, China

- This paper presents a haptic feedback based laparoscope movement perception method that serves as a controlling function in performing the laparoscope movement.
- During the tracking, haptic feedback informs a surgeon about the direction of laparoscope movement to enhance surgeons' control over the laparoscopic view.
- The experimental results show that the proposed method can effectively control the movement of a laparoscopic robot and provide haptic feedback to a surgeon.



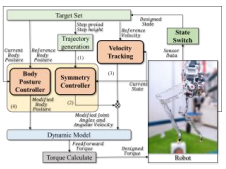
Framework of proposed method

SuPMR8.5 **ID:174** 16:15 - 16:30

Motion Control for Underactuated Robots Adaptable to Uneven Terrain by Decomposing Body Balance and Velocity Tracking

Xishuo Zhu, Lvyan Wang, Zhangguo Yu, Xuechao Chen, Lianqiang Han
School of Mechatronical engineering, Beijing Institute of Technology, China

- The motion control is decomposed into a body balance control and velocity tracking control
- Body balance control stabilizes the body posture and position
- Velocity tracking control adjusts the velocity of walking.
- Dynamics feedforward torque and proportional–derivative control works at the joint end.

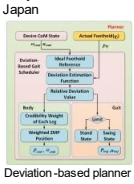


SuPMR8.6 **ID:180** 16:30 - 16:45

Online Locomotion Planner For Wheeled Quadrupedal Robot Using Deviation Based Scheduler

Zhihao Zhang, Fei Meng, Lei Wang, Kang Ru, Sai Gu, Botao Liu, Xuxiao Fan, Qiang Huang
School of Mechatronical Engineering, Beijing Institute of Technology, China
Aiguo Ming
Department of Mechanical Engineering and Intelligent Systems, The University of Electron-Communications, Japan

- Proposed a deviation-based online locomotion planner for Wheeled Quadrupedal Robot.
- Established a deviation estimate method to appraise the robot state.
- Simulation experiment results show the advantages in efficiency and stability of this method.



Deviation-based planner

SuPMR8: Regular Session (Locomotion Control)

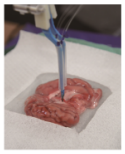
Session Chairs: Wen Qi, University of Science and Technology of China, China
Tao Zhang, University of Science and Technology of china, China
Empark Grand Hotel, No. 1 Conference Room, 15:45 - 17:00, Sunday, July 4, 2021

SuPMR8.7 **ID: 12** 15:45 - 16:00

The Planar Force Perception on Robotic Bipolar Forceps

Xiu-Heng Zhang
Mechanical Engineering College, Shenyang Ligong University, China
Heng Zhang, Zhen Li and Gui-Bin Bian
Institude of Automation, Chinese Academy of Sciences, China

- Developed a robotic bipolar forceps.
- Found the optimal position for installing the sensors is 19-21 mm from the tips.
- Built a planar force sensing function on forceps with a resolution to 0.01 N.
- Gathered the interaction force information of Forceps-Grapes and Forceps-Vitro Pig Brain.



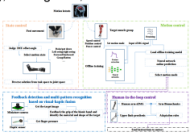
The Robotic Bipolar Forceps

SuPMR8.8 **ID:125** 16:00 - 16:15

An Intelligent Upper Limb Prosthesis with Crossmodal Integration and Recognition

Qingsheng Meng, Zhijun Li
the Department of Automation,
University of Science and Technology of China, Hefei,China
Junjun Li
the College of Automation Science and Engineering,
South China University of Technology, Guangzhou, China

- A modularly designed intelligent upper limb prosthesis.
- A crossmodal-based integration control method for intelligent upper limb prosthesis.
- Feedback detection and multi-pattern recognition based on visual-haptic fusion



Block diagram of the crossmodal-based integration control strategy

SuPMR8.9 **ID:140** 16:15 - 16:30

Active Learning Strategy of Finger Flexion Tracking using sEMG for Robot Hand Control

Wen Qi and Hang Su
University of Science and Technology of China, China
Politecnico di Milano, Italy
Junhao Zhang, Giancarlo Ferrigno, Elena De Momi, and Andrea Aliverti
Politecnico di Milano, Italy
Rong Song
Sun Yat-sen University, China

- An active learning strategy is proposed to track finger flexion based on high dimension sEMG signals.
- A novel sEMG signal processing method is combined for noise and outlier removal.
- A block segmentation-based sliding window approach is designed to achieve online prediction and enhance accuracy.

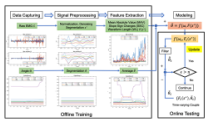


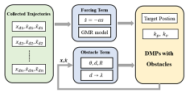
Fig. 3 The active learning framework

SuPMR8.10 **ID:161** 16:30 - 16:45

Dynamical Movement Primitives of Crossing over Obstacles for a Lower-Limb Prosthesis

Tao Zhang, Zhijun Li and Qinjian Li
The Department of Automation, University of Science and Technology of china, Hefei,China
Ying Feng
The College of Automation Science and Engineering,South China University of Technology, Guangzhou,China

- Gaussian mixture regression conjunction with DMPs is used to reproduce trajectory
- An obstacle term is added to DMPs for crossing over obstacle
- The feasibility of crossing over obstacle is verified by simulation



Overview of the modified DMPs

Monday
July 5, 2021

9:00 - 11:00	Regular Session MoAMR1: Robot Localization	Banquet Hall 3
	Regular Session MoAMR2: Trajectory Planning	Banquet Hall 4
	Regular Session MoAMR3: Unmanned Systems	International Hall
	Regular Session MoAMR4: Control System Modeling & Intelligent Learning and Control	No. 1 Conference Room

MoAMR1: Regular Session (Robot Localization)

Session Chairs: Kaicheng Ruan, University of Macau, China

Yangxin Xu, The Chinese University of Hong Kong, China

Empark Grand Hotel, Banquet Hall 3, 9:00 - 11:00, Monday, July 5, 2021

MoAMR1.1 **ID:29** 9:00 - 9:15

Robust Mapping and Localization in offline 3D point cloud maps

Guo He, Fei Zhang, Xiang Li and Weiwei Shang

Department of Automation, University of Science and Technology of China, China

- This paper introduces a robust mapping and localization (RMAL) method assisted by muti-sensors.
- The saved offline map will be matched and jointly optimized with the online map.
- Experiments are executed in actual different scenarios using a crawler-type fire-fighting robot.

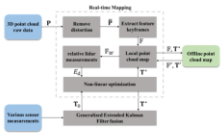


Fig.1. Structural framework of the method

MoAMR1.2 **ID:52** 9:15 - 9:30

Global Localization for Single 3D Point Cloud using Voting Mechanism

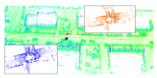
Y.Jin, Q.Chen J.Qian and J.Liu

College of Computer Science and Technology, Zhejiang University of Technology, Hangzhou, China

J.Zhang

School of Computer Science and Engineering, Tianjin University of Technology, Tianjin, China

- A global localization method for single point cloud
- Reduce the walking time of robots in unknown environments
- A coarse-fine voting mechanism for selecting candidates



An illustration of a robot visited the same place

MoAMR1.3 **ID:55** 9:30 - 9:45

A GRAPH-BASED VISUAL SLAM SYSTEM FUSING MULTIPLE FEATURE

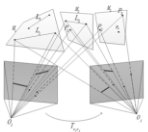
Zhenzhong Yu

HRG International Institute (Hefei) for Research & Innovation, China

Qiang Liang Siqi Zhang and Xiaolei Chen

Harbin University of Science and Technology, China

- AT-FAST algorithm is used to solve the problem that traditional FAST features hold feature block.
- I-LSD algorithm improve the matching accuracy by reducing the redundancy of line segments.
- using MPR to express plane segments to reduce the amount of calculation.
- our algorithm can improve the positioning accuracy by 37.8% compared with ORB-SLAM .



The re-projection diagram of fused features

MoAMR1.4 **ID:64** 9:45 - 10:00

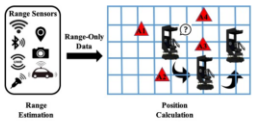
Improving The Robot Localization Accuracy Using Range-only Data: An Optimization Approach

Kaiwen Xue, Jiayuan Li, Nan Xiao, Jiawei Liu, Xiaoqiang Ji, Huihuan Qian

Shenzhen Institute of Artificial Intelligence and Robotics for Society (AIRS)

The Chinese University of Hong Kong, Shenzhen, China

- A method to improve localization accuracy with range-only data.
- Turning the non-convex model to a convex model with optimization techniques.
- The quantitative evaluation of the localization accuracy increases by 61.29% in simulation and 39.03% in field .



MoAMR1.5 **ID:66** 10:00 - 10:15

Homography-driven plane feature matching and pose estimation

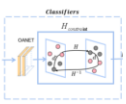
Luzhen Ma, Kaiqi Chen and Jialin Liu

College of Computer Science and Technology, Zhejiang University of Technology, China

Jianhua Zhang

Computer Science and Engineering,Tianjin University of Technology, Tianjin, China

- A novel plane constraint is proposed to learn plane feature matching
- We collected a dataset consisting of planar labels
- We propose a SLAM framework which combines label, plane feature matching and poses estimation



Classfier with homography constraint

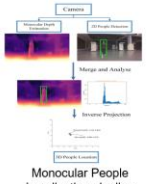
MoAMR1.6 **ID:115** 10:15 - 10:30

Real-time Monocular 3D People Localization and Tracking on Embedded System

Yipeng Zhu, Tao Wang* and Shiqiang Zhu

Ocean College, Zhejiang University, China

- Real-time monocular 3D people localization working on Embedded system at 12 fps (Nvidia Jetson Xavier NX)
- Utilizing monocular depth estimation, 2D detection results and distribution analysis to find 3D location.
- People localization and tracking error evaluated, the proposed lightweight and cost-effective implementation validated.



Monocular People Localization pipeline

MoAMR1: Regular Session (Robot Localization)

Session Chairs: Kaicheng Ruan, University of Macau, China

Yangxin Xu, The Chinese University of Hong Kong, China

Empark Grand Hotel, Banquet Hall 3, 9:00 - 11:00, Monday, July 5, 2021

MoAMR1.7 **ID:137** 10:30 - 10:45

Design and Development of a New Autonomous Disinfection Robot Combating COVID-19 Pandemic

Kaicheng Ruan, Zehao Wu, Iong Chio, Yaowen Zhang, and Qingsong Xu

Department of Electromechanical Engineering, Faculty of Science and Technology, University of Macau, Macau, China

- A new cost-effective autonomous intelligent indoor disinfection robot is designed for automated disinfection work
- It integrates the Hydrogen Peroxide Vaporous and SLAM for automated disinfection operation in complex indoor environment
- The effectiveness of the developed robot has been verified in real environments, such as hotel and hospital

MoAMR1.8 ID:158 10:45 - 11:00

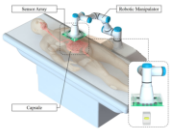
Design Approach of 3D Optimal Mobile Sensor Array for Confidence-box based Tracking of a Magnetic Capsule

Yangxin Xu[1], Keyu Li[1], Ziqi Zhao[2] and Max Q.-H. Meng[1,2]

[1] Department of Electronic Engineering, The Chinese University of Hong Kong, Hong Kong SAR, China

[2] Department of Electronic and Electrical Engineering, the Southern University of Science and Technology, Shenzhen, China

- We present a novel approach for designing the optimal 3D sensor array layout with a "confidence-box".
- The confidence-box based tracking is proposed to locate a capsule in the intestine.
- Through the simulation experiments, the confidence-box based tracking has much more accurate results and larger workspace than the fixed sensor array based localization.



Confidence-box based Tracking

MoAMR2: Regular Session (Trajectory Planning)

Session Chairs: Jianxiao Chen, Tongji University, China

Zhaoxing Chen, Anhui University of Technology, China

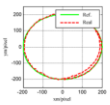
Empark Grand Hotel, Banquet Hall 4, 9:00 - 11:00, Monday, July 5, 2021

MoAMR2.1 **ID:34** 9:00 - 9:15

Visual Trajectory Tracking Control of Non-Holonomic Mobile Robots A Cascaded Approach

Yuanxu Zhang and Qingwei Liang and Jian Gao
School of Marine Science and Technology, Northwestern Polytechnical University ,China

- A visual-based trajectory tracking controller of non-holonomic mobile robots using a nonlinear cascaded approach.
- Globally asymptotically stable controllers are designed using the backstepping method for them, and the stability of the system is proved using the cascaded system theory.
- This method simplifies the design of the visual trajectory tracking controller for mobile robots.

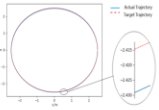


MoAMR2.2 **ID:54** 9:15 - 9:30

A Trajectory Tracking Control Algorithm of Nonholonomic Wheeled Mobile Robot

Rui Deng, Qingfang Zhang, Rui Gao, Mingkang Li, Peng Liang and Xueshan Gao
School of Mechatronical Engineering, Beijing Institute of Technology, China

- Modelling of nonholonomic wheeled mobile robot
- Trajectory tracking control law based on deep reinforcement learning
- Deep deterministic policy gradient(DDPG)



Simulation of trajectory tracking algorithm

MoAMR2.3 **ID:65** 9:30 - 9:45

Trajectory Planning Approach of Mobile Robot Dynamic Obstacle Avoidance with Multiple Constraints

Xuehao Sun
School of Mechanical Engineering, Anhui University of Technology, China
Shuchao Deng and Baohong Tong
Anhui Province Key Laboratory of Special Heavy Load Robot and the School of Mechanical Engineering, Anhui University of Technology, China

- Workspace potential field must be established to solve the optimal speed of the robot
- A costmap needs to be established to detect dynamic obstacles
- Obstacle avoidance strategies based on the relative motion relationship between dynamic obstacles and the robot
- By combining multiple constraints, the collision-free trajectory planning is completed

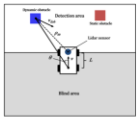


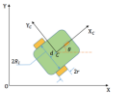
Diagram of obstacle detection costmap

MoAMR2.4 **ID:87** 9:45 - 10:00

Single Network Robust Adaptive Critic-Based Trajectory Tracking Control for Wheeled Mobile Robot with Wheel Sliding

Hongze Wang
School of Artificial Intelligence, University of Chinese Academy of Sciences, Beijing
Jinxin Zhang
Institute of Automation, Chinese Academy of Sciences, Beijing

- The trajectory tracking performance of wheeled mobile robot is affected by wheel sliding.
- A one-step single network robust optimal tracking method is proposed.
- A special reward function is designed to guarantee asymptotic stability of the tracking errors.
- The proposed algorithm can achieve robust tracking control.



The WMR's structure

MoAMR2.5 **ID:99** 10:00 - 10:15

A swing-foot trajectory generation method for biped walking

Huanzhong Chen, Xuechao Chen, Zhangguo Yu, Chencheng Dong, Qingqing Li, Runming Zhang, Qiang Huang
School of Mechatronical Engineering, Beijing Institute of Technology, China

- Fast motion of swing foot influence the feasibility of trajectory and the balance of robot
- With the proposed optimization form, most constrains are levitated, leading to a fast trajectory generation
- Stable walking of 4km/h is achieved with the optimized swing-foot trajectory

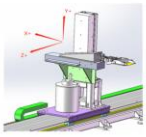
4km/h walking experiment

MoAMR2.6 **ID:151** 10:15 - 10:30

Complex trajectory planning based motion control algorithm for compliance composite rod scraper robot

Min Zhang, Wenxia Xu, Baocheng Yu, Deng Cheng, Jing Wu
Hubei Key Laboratory of Intelligent Robot, Wuhan Institute of Technology, China
Moutang Fan
Lingyun Science and Technology Group Company,China
Jian Huang
School of Automation, Huazhong University of Science and Technology, China,

- The mechanism and principle of the composite rod scraper robot are first introduced.
- According to the scraping model of rectangular composite rod and the process of mandrel rotation, the trajectory of the scraper head is analyzed.
- The trajectory planning method for the rectangular composite rod is presented.



The compliance composite rod scraper robot

MoAMR2: Regular Session (Trajectory Planning)

Session Chairs: Jianxiao Chen, Tongji University, China

Zhaoxing Chen, Anhui University of Technology, China

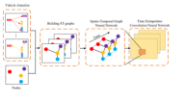
Empark Grand Hotel, Banquet Hall 3, 9:00 - 11:00, Monday, July 5, 2021

MoAMR2.7 **ID:163** 10:30 - 10:45

Attention Based Graph Convolutional Networks for Trajectory Prediction

Jianxiao Chen, Guang Chen and Ya Wu
School of Automotive Studies, Tongji University, China
Zhijun Li
Department of Automation, University of Science and Technology, China
Alois Knoll
Department of Informatics, Technical University of Munich, Germany

- A spatial attention based spatial-temporal graph convolutional network is proposed.
- The social interactions among the vehicles are modeled by assigning different attention weight to edges of the graph.
- Improving the preidction precision and reducing the algorithm complexity.



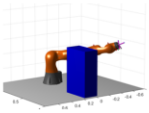
Overview Architecture

MoAMR2.8 **ID:186** 10:45 - 11:00

Motion Planning of 7-DOF Manipulator Based on Quintic B-Spline Curve

Zhaoxing Chen and Xiangrong Xu
School of Mechanical Engineering, Anhui University of Technology, China
Aleksandar Rodic and Petar B. Petrovic
University of Belgrade, Serbia

- The improved RRT algorithm is used to quickly plan the robot path.
- The quintic quasi uniform B-spline function is used to fit the trajectory.
- Use the improved particle swarm optimization algorithm to optimize the trajectory of the robot.
- The improved particle swarm optimization algorithm achieves the balance of time and stability.



Motion planning of robot

MoAMR3: Regular Session (Unmanned Systems)

Session Chairs: Yang Zhou, Northwestern Polytechnical University, China

Chao Yao, Shenzhen University, China

Empark Grand Hotel, International Hall, 9:00 - 11:00, Monday, July 5, 2021

MoAMR3.1 ID:11 9:00 - 9:15

Non-model friction disturbance compensation for a pan-tilt based on MUAV

Xiangyang Zhou, Tongtong Shu and Hao Gao
School of Instrumentation and Optoelectronics Engineering, Beihang University, China

- A new non-model friction compensation method for a pan -tilt is proposed.
- The fuzzy controller is applied to the position loop to compensate the friction disturbance
- Simulations and experiments are carried out to validate the effectiveness of the proposed method.
- The control performance of pan -tilt based on MUAV is improved significantly.

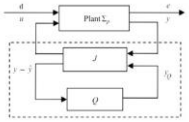
The remote sensing system of the MUAV

MoAMR3.2 ID:74 9:15 - 9:30

An Improved Vibration Controller for Precision Manufacture Based on Youla Parametrization and Fuzzy Logic

Qimin Li, Li Ke, Huayan Pu, Jin Yi, Jie Ma, Ruqing Bai, Jinglei Zhao and and Jun Luo
College of Mechanical and Vehicle Engineering, Chonging University, China

- Construct a set of parameterized stable controllers based on Youla parameterization.
- Use adaptive algorithm to adjust Youla parameters online.
- Use fuzzy control to improve the forgetting factor of the adaptive algorithm.
- Use the improved youla algorithm to evaluate benchmark problems.



Block diagram of the closed loop system with a Q-parameterized controller

MoAMR3.3 ID:71 9:30 - 9:45

Game Theoretic Modeling and Decision Making for Connected Vehicle Interactions at Urban Intersections

Jiacheng Cai, Peng Hang, and Chen Lv
School of Mechanical and Aerospace Engineering, Nanyang Technological University, Singapore

- Proposes a meta decision -making model for connected vehicle interaction s based on game -theoretic inference;
- The dominant strategy owner in an interaction plays the leading role in determining the outcome;
- Egoism, Aggressiveness and Rationality (*EAR)* will be the key attributes of the refined model.

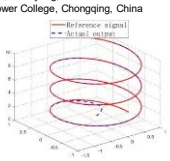
An interactive problem between two connected vehicles at an urban intersection.

MoAMR3.4 ID:63 9:45 - 10:00

Adaptive Output Feedback Dynamic Surface Control for a Class of Quadrotor UAVs with External Disturbance

He Li [1,2], Shunjiang Wang [3], Ning Xu [1,2], Xiuyu Zhang [1,2], Yan Li [4] and Guoqiang Zhu [1,2]
[1,2] School of Automation Engineering, Northeast Electric Power University, Jilin, China
[1,2] Jilin Province International Research Center of Precision Drive and Intelligent Control
[3] State Grid Liaoning Electric Power Co., Ltd, Shenyang, China
[4] College of Electrical Engineering, Chongqing Electric Power College, Chongqing, China

- An Adaptive Output Feedback Dynamic Surface control scheme is proposed for Quadrotor UAVs with External Disturbance
- Aiming at the problem that some states of the quadrotor UAV cannot be measured during flight, a state observer is designed
- Simulink simulation platform is established in MATLAB to verify the effectiveness of the proposed control algorithm.



The 3-D tracking effect diagram of quadrotor UAVs

MoAMR3.5 ID:70 10:00 - 10:15

Locomotion Control for a Land-Air Hexapod Robot

Yinshuai Sun, Zhongliang Jing, Peng Dong and Jianzhe Huang
School of Aeronautics and Astronautics, Shanghai Jiao Tong University, Shanghai, China
Wujun Chen
School of Naval Architecture, Ocean & Civil Engineering, Shanghai Jiao Tong University, Shanghai, China

- A land-air hexapod robot is custom -designed
- This robot climbs like a hexapod robot and flies like a multi -copter UAV
- Control methods are developed for both ground and air locomotion
- Simulations and actual experiments are conducted

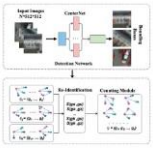
The customized-designed land-air hexapod robot

MoAMR3.6 ID:30 10:15 - 10:30

Person Counting Based On Graph Relation Network Using UAV

Xiaonan Hu, Zun Liu, Jie Chen, Tingbo Chen, Zhuangzhuang Chen and Jianqiang Li *
College of Computer Science and Soft Engineering , Shenzhen University, China

- A novel GSPCN, which can accurately calculate the number of people in large -scale construction site.
- Collected a large -scale scene video dataset from the perspective of UAVs in different construction sites.
- The proposed algorithm is tested on real data set and simulation environment. The results show that our method is better than the existing methods.



MoAMR3: Regular Session (Unmanned Systems)

Session Chairs: Yang Zhou, Northwestern Polytechnical University, China

Chao Yao, Shenzhen University, China

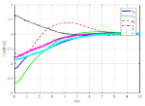
Empark Grand Hotel, International Hall, 9:00 - 11:00, Monday, July 5, 2021

MoAMR3.7 ID:38 10:30 - 10:45

Visual Servo Control of Underwater Vehicle Based on Image Moment

Yang Zhou and Jian Gao and Xuman An
School of Marine Science and Technology, Northwestern Polytechnical University ,China

- An image moments -based Six degrees of freedom (DOF) visual servo control method for underwater vehicles
- To estimate the pitch and roll angles with image moments, a multi -layer neural network is employed
- The stability of the proposed visual servo control is analyzed by a Lyapunov -based method



MoAMR3.8 ID:67 10:45 - 11:00

Optimal Capacity Allocation and Caching Strategy for Multi-UAV Collaborative Edge Caching

Chao Yao, Chuangkun Jiang, Zun Liu, Jie Chen, and Jianqiang Li *
College of Computer Science and Software, Shenzhen University, Shenzhen, China

MoAMR4: Regular Session (Control System Modeling & Intelligent Learning and Control)

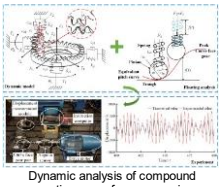
Session Chairs: Haitao Wang, University of Science and Technology of China, China
Xinyu Gao, University of Science and Technology of China, China
Empark Grand Hotel, No. 1 Conference Room, 9:00 - 10:45, Monday, July 5, 2021

MoAMR4.1 **ID:146** 9:00 - 9:15

Research on the Time-varying Dynamic Characteristics of Compound Motion Curve Face Gear Pair

Yongquan Yu and Chao Lin and Yanan Hu
State Key Laboratory of Mechanical Transmission , Chongqing University, China
Chunjiang He
School of Mechanical and Power Engineering , Chongqing University of Science and Technology, China

- This gear pair can build variable transmission ratio and rotation/movement compound motion simultaneously
- The anti-floating design of the pinion is presented
- The dynamic model of the gear pair is established and the response characteristics are analyzed
- The rationality and correctness of the theoretical analysis are verified by experiment



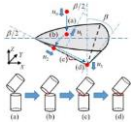
Dynamic analysis of compound motion curve face gear pair

MoAMR4.2 **ID:152** 9:15 - 9:30

Compliant Peg-in-Hole Assembly for Components with Grooves Based on Attractive Region in Environment

Yang Liu
School of Mechanical Engineering, USTB , China
Ziyu Chen
Department of Automation , USTC , China
Xiaodong Zhang
Beijing Key Laboratory of Intelligent Space Robotic Systems Technology and Applications, Beijing Institute of Spacecraft System Engineering , China
Jie Gao and Hong Qiao
Institute of Automation, Chinese Academy of Sciences , China

- Sub-targets of the assembly are designed according to the geometric characteristics of the constraint region
- Low dimensional attractive regions are utilized to solve the jamming caused by the grooves
- Impedance control is applied to guarantee the compliance of assembly

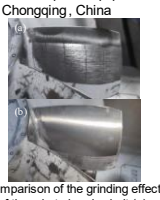


MoAMR4.3 **ID:157** 9:30 - 9:45

Process Analysis and Experimental Research of Robot Abrasive Belt Grinding for Blisk

Guijian Xiao, Kangkang Song and Shulin Chen
College of Mechanical and Vehicle Engineering , Chongqing University, China
Rentao Wen and Xiao Zou
Chongqing Material Surface Precision Machining and Complete Equipment Engineering Technology Research Center , Chongqing, China

- The process of robot abrasive belt grinding is analyzed and experiments are carried out for blisk
- Compared with manual polishing, robot abrasive belt grinding efficiency is increased by 1.5 times
- The surface roughness can reach Ra0.24 μm
- Blisk blades after polishing have good consistency, the milling cutter lines are effectively removed



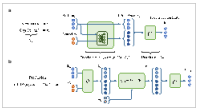
Comparison of the grinding effect of the robot abrasive belt.(a) Before grinding (b) After grinding

MoAMR4.4 **ID:56** 9:45 - 10:00

Deep Koopman Operator Based Model Predictive Control for Nonlinear Robotics Systems

Xuefeng Wang, Yu Kang,, Yang Cao
Automation,University of Science and Technology of China, China

- Deep Koopman Predictor for global linearization of nonlinear robot systems.
- Loss function ensures that the lifting space is linear and reversible with the original space
- DKoopman-MPC: Linear MPC in the embedded space to effectively control the nonlinear system.



The DKoopman-predictor architecture

MoAMR4: Regular Session (Control System Modeling & Intelligent Learning and Control)

Session Chairs: Haitao Wang, University of Science and Technology of China, China
Xinyu Gao, University of Science and Technology of China, China
Empark Grand Hotel, No. 1 Conference Room, 9:00 - 10:45, Monday, July 5, 2021

MoAMR4.5 **ID: 124** 10:00 - 10:15

A Comparative Study of Linear Discriminant Analysis and Multi-Class LPBoost Based on EMG Pattern Recognition

Yuzhu Liu and Hang Su
School of Data Science, University of Science and Technology of China , China
Institute of Advanced Technology, University of Science and Technology of China, China
Junjun Li
College of Automation Science and Engineering, South China University of Technology, China

- Purpose: upper limb motion classification based on EMG signals for human -robot interaction design.
- Multi -Class LPBoost and Linear Discriminant Analysis classification algorithm
- Segmentation and feature extraction of EMG signals.

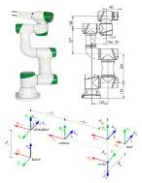
Electromyography collection and classification

MoAMR4.6 **ID:143** 10:15 - 10:30

Dynamic Model Identification of Collaborative Robots Using a Three-Loop Iterative Method

Jie Deng, Weiwei Shang, Bin Zhang and Shuang Cong
Department of Automation, University of Science and Technology of China, China
Shengchao Zhen
School of Mechanical Engineering, HeFei University of Technology, China

- This paper presents a three -loop iterative method for the dynamic model identification of collaborative robots.
- Viscous friction nonlinearity and a minor Stribeck effect are considered to achieve better identification results.
- Experiments on a six -dof collaborative robot have proved the superiority of our method.



MoAMR4.7 **ID: 155** 10:30 - 10:45

Design and Experimental Verification of an Intelligent Fire-fighting Robot

Xinyu Gao, Fei Zhang, Chenyu Chaoxia, Guo He, Baochen Chong, Shunxiang Pang, and Weiwei Shang
Department of Automation, University of Science and Technology of China, China

- An intelligent fire -fighting robot is designed for the substation environment to perform autonomous navigation and autonomous fire extinguishing tasks.
- A multi -modal detection algorithm is developed to identify the flame.
- A simple water jet model is used to adjust the orientation of the water cannon .
- The fire extinguishing ability of the robot is verified in actual experiments.

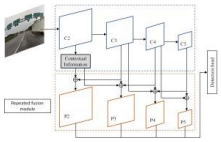
Fig1. The hardware structure of the fire -fighting robot

MoAMR4.8 **ID:162** 10:45 - 11:00

Traffic Sign Detection using Feature Fusion and Contextual Information

Haitao Wang, Guang Chen and Zhengfa Liu
School of Automotive Studies, Tongji University, China
Zhijun Li
Department of Automation, University of Science and Technology of China

- A feature fusion method via cross connection is proposed to obtain semantic and geometrical information simultaneously.
- A contextual information module with four paralleled branches is built to search background information for small traffic signs.
- Compared with baseline, our method performs better in small traffic sign detection.(~1.4% increase)



Pipeline of our model

INDEX OF AUTHORS

Xu, Xiangrong	SaPMR3.10
Xu, Xiangrong	SuPMR3.3
Xu, Xiangrong	SuPMR4.3
Xu, Yangxin	MoAMR1.8
Xue, Kaiwen	MoAMR1.4

-Y-

Yang, Bo	SuPMR3.5
Yang, Liangjing	SaPMR4.10
Yao, Zong	SuPMR8.1
Yao1, Yuwu	SuPMR7.10
Yu, Jiahui	SaPMR3.2
Yu, Yinghong	SaPMR1.10
Yu, Yongquan	MoAMR4.1
Yuan, Jianbo	SuPMR6.9
Yuan, Jianbo	SuPMR2.5
Yuan, Mingxin	SaPMR4.6
Yue, Ming	SuPMR5.2

-Z-

Zhang, Guoqing	SuPMR7.6
Zhang, Jianhua	MoAMR1.2
Zhang, Jianhua	SaPMA1.3
Zhang, Jianhua	MoAMR1.5
Zhang, Jin	SaPMR2.5
Zhang, Jun	SuPMR2.2
Zhang, Junqi	SaPMR3.1
Zhang, Kuangen	SuPMR5.7
Zhang, Kuangen	SaPMR3.7
Zhang, Longbin	SaPMA3.1
Zhang, Tao	SuPMR8.10
Zhang, Teng	SuPMR3.1
Zhang, Xinyu	SaPMA4.6
Zhang, Yinliang	SaPMR4.8
Zhang, Ziwei	SaPMR1.9
Zhanga, Xiaozhi	SaPMR4.5
Zhao, Haifeng	SuPMR8.2
Zhao, He	SuPMR1.1
Zhou, Jiakang	SuPMR3.6
Zhou, Zhijie	SaPMR2.7
Zhu, Guoqiang	MoAMR3.4
Zhu, Xishuo	SuPMR8.5
Zhu, Yipeng	MoAMR1.6
Zhuang, Yulun	SuPMR3.2

SPECIAL ISSUES

Autonomous System in Robotic Surgery: Current Challenges in Design, Modeling, Perception, Control and Applications

I. Introduction

The advent of robot-assisted surgery has consistently improved the outcome of surgical procedures by providing more effective and precise medical interventions. Hence, in recent years, autonomous systems in robotic surgery have attracted growing research interests in an enormous scope of applications. Concurrently to the growing needs and requests of sophisticated mechanisms that can help, enhance the medical procedure and in some extent replace the medical practitioners, concerns related to the safety of completely autonomous surgical robotic systems have emerged during the years. Hence, how to integrate advanced designs, modeling, perception, learning, control, and cognition, which involve the highest levels of the imaginative ability to bring the multi-information together and create novel solutions, is an effective way to enhance the level of autonomy of intelligent surgical robotic system and it is becoming an inspiring and promising subject which aim at improving the performance of robotics surgery. However, there are still many challenges and problems related to safety of autonomous robotic surgical systems and their integration with the medical team which can be tackled only by developing more advanced robotic solutions.

Topics of interest for this special issue include and include but not limited to:

- Autonomous /semi-autonomous system for robotic-assisted surgery;
- Haptic mechanism in robotic surgery;
- Teleoperated system in robotic-assisted surgery;
- Image guided robotic-assisted surgery;
- Human-Robot interaction and collaboration in surgical systems;
- Sensory fusion and perception in surgical robotics;
- Interface in robotics surgery;
- Safety and robustness of robotic surgery devices.

II. Important Dates

- 15 October 2020: Call for Paper

- 10 January 2021: Papercept open for submission
- 10 February 2021: Submission deadline
- 07 May 2021: Authors receive RA-L reviews and recommendation
- 21 May 2021: Authors of accepted MS submit final RA-L version
- 06 June 2021: Authors of R&R MS resubmit revised MS
- 11 July 2021: Authors receive final RA-L decision
- 25 July 2021: Authors submit final RA-L files
- 30 July 2021: Camera ready version appears in RA-L on Xplore
- 10 August 2021: Final Publication

III. Guest Editors

Angela Faragasso, University of Tokyo, Japan, Email: Angelafar86@gmail.com
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IEEE Transactions on Fuzzy Systems

Special Issue on Cyborg Intelligence: Human Enhancement with Fuzzy Sets

I. Aim and Scope

Well-known scientists and experts have expressed concern that robots may take over the world. More generally, there is concern that robots could take over human jobs and leave billions of people suffering long-term unemployment. Yet, such concerns ignored the potential of intelligence techniques to enhance the natural capabilities of human beings with in-the-body technologies and so become cyborgs with superior capabilities to robots. Cyborg intelligence is dedicated to improving the natural capabilities of human beings by integrating AI with biological intelligence and in-the-body technologies through tight integrations of machines and biological beings. The most critical challenges of cyborg intelligence include information fusion in sensory-motor integration, cognitive computational models, fuzzy control of cyborg systems, and related topics. Among these issues, fuzzy logic is a high-efficiency problem-solving control system that imitates the way people solve problems under uncertain, ambiguous, noisy, and even missed input information. Besides, the fuzzy logic system can use all the input and output data needed in processing. The key idea with the fuzzy logic is that inputs are taken from sensors having a certain value and transformed into membership values varying from 0 to 1. Recent theoretical developments on fuzzy sets provide novel perspectives for the key mechanisms of decision making and information processing in cyborg systems.

The goal of this special issue is to promote human enhancement with fuzzy systems through the theoretical frameworks of cyborg intelligence and publish frontier research and practical applications, which are concerned with hybrid fusion of organic and biomechatronic body parts with the integration of technologies including sensing, cognition, and fuzzy control across or between machines, humans, and organizations, where the sensing data should be comprehensively analyzed to help the robot take corresponding decisions concerning its position or other movements, and the fuzzy logic system is used for the artificial intelligence control algorithm of the cyborgs. Furthermore, the combination of new technologies, efficient scientific and engineering solutions, visions for future research, and the development of cyborg intelligence with fuzzy systems will also be provided.

With the rapid development of bionic technology, it is believed cyborg intelligence can assist humans to conquer many natural limitations such as disability, speed, strength, as well as intelligence. However, many challenges will still lie ahead. Thus, this special issue serves as an essential and timely update on this topic and should be of interest to potential readers.

II. Topics Covered

The lists of possible topics include, but are not limited to:

- Fuzzy-based augmented cognition and decision making on cyborg intelligence
- Fuzzy mechanisms for learning approaches and data-driven approaches to cyborg systems
- Computational intelligence methods via fuzzy logic (Energy-efficient optimization problem) with applications to cyborg systems
- Fuzzy-based sensing, fusion, and features extraction on cyborg intelligence
- Human-In-the-loop fuzzy control in human-centered cyborg systems
- Fuzzy control theory through extensions of ordinary fuzzy sets on cyborg control
- Applications of fuzzy-based cyborg intelligence on rehabilitation robotics, prosthesis and exoskeleton robotics, medical and surgical robots, biomimetic robots

III. Submission Guidelines

All authors should read 'Information for Authors' before submitting a manuscript at http://cis.ieee.org/ieeetransactions- on-fuzzy-systems.html

Submissions should be through the IEEE TFS journal website

http://mc.manuscriptcentral.com/tfs-ieee

Submissions should also be in the correct format

http://ieeeauthorcenter.ieee.org/create-your-ieeearticle/

use-authoring-tools-and-ieee-articletemplates/ieee-article-templates/templates-for-transactions/.

It is essential that your manuscript is identified as a Special Issue contribution:

- Ensure you choose 'Special Issue' when submitting.
- A cover letter must be included which includes the title 'Special Issue on Cyborg Intelligence: Human Enhancement with Fuzzy Sets'.

IV. Important Dates

- 30 September 2021: Submission deadline
- July 2022: Notification of first round of reviews
- September 2022: Revised submissions due (for guidance only)
- November 2022: Final notice of acceptance/rejection

V. Guest Editors

Lead Guest Editor

- Zhijun Li, University of Science and Technology of China, China, Email: zjli@ieee.org
- Jian Huang, Huazhong University of Science and Technology, China, Email: huang_jan@mail.hust.edu.cn

Co-Guest Editor

- Hang Su, Politecnico di Milano, Italy, Email: hang.su@polimi.it
- Zhaojie Ju, University of Portsmouth, UK., UK, Email: zhaojie.ju@port.ac.uk

IEEE Journal of Biomedical and Health Informatics

Special Issue on AI-driven Synthetic Biology for Human Wellbeing

I. Introduction

Synthetic biology aims at the rational design and transformation of biological systems, and it is characterized by the integration of traditional biology, engineering, computer science and other disciplines. Synthetic biology has shown great development potential in recent years. However, the biological system is extremely complex, which is difficult accurately describe by traditional mathematical model. And it is also still unable to effectively predict the complex gene lines. In this background, construction of AI-driven engineering platform is an important research method of synthetic biological system.

With the rapid development of artificial intelligence in recent years, its continuous learning ability based on massive data and intelligent exploration ability in unknown space effectively meet the needs of the current trial and error platform for synthetic biological systems engineering. Through data driven and continuous learning, the deep integration of artificial intelligence and synthetic biology is the general trend, which brings new opportunities for the development of synthetic biology.

In this special issue, we are looking for emerging technologies, novel studies, and promising developments, which can realize and elevate the effectiveness and advantages of AI-driven synthetic biology for human wellbeing.

Topics of interest include, but are not limited to, the following:

- Graph neural network in synthetic biology
- Reinforcement learning in synthetic biology
- Meta learning in synthetic biology
- Explainable AI in synthetic biology
- AI-driven synthetic biology based drug development
- AI-driven synthetic biology based diagnostic techniques
- Construction of AI-driven synthetic biological information database
- AI-driven gene sequence analysis technology
- AI-driven synthetic biology for intelligent health system
- Data classification and clustering for intelligent health system
- AI-driven synthetic biology for vaccine development

II. Key Dates

- 30 September 2021: Submission deadline
- 30 October 2021: First Reviews Due
- 30 November 2021: Revised Manuscript Due
- 30 December 2021: Final Decision

III. Guest Editors

- Houbing Song, Embry-Riddle Aeronautical University, USA, Email: h.song@ieee.org.com
- Yuan Zhang(AE), Southwest University, China, Email: yuanzhang@swu.edu.com
- Jose Neuman Souza, Universidade Federal do Ceara, Brazil, Email: neuman@ufc.br
- Jianqiang Li, Shenzhen University, China, Email: lijq@szu.edu.cn

Frontiers in Robotics and AI Field Robotics Sensor Fusion and Machine Perception Robotic Control Systems

Special Issue on Telerobotics in Demanding Environments

I. Introduction

In demanding work environments, for example, nuclear, chemical, disaster response, construction/demolition, mining, submarine tasks, there are extreme risks to the health and safety of human workers. Telerobotics is an obvious solution that can remove/distance people from such dangers. Advanced telerobotics technologies linked to dexterous locomotion and mobile manipulation platforms can substitute or assist workers in all stages, reducing or eliminating their exposure to hazards. There are two parts involved, for robots to be able to physically perform tasks and to problem-solve in complex environments. First, is the capabilities of the robot itself. This includes manipulation, locomotion, sensing, the capacity to withstand harsh conditions, etc. Second, is intelligent user interaction interface(s) that allow the human operator to intuitively control the task execution through immersive remote teleoperation.

The aim of this Research Topic is to capture promising research trends in Telerobotics in Demanding Environments. There are three key domains in remote telerobotic task execution: (i) Operator situational awareness through perception (visual, haptic, acoustic, etc.), cognition, and control in the remote environment; (ii) Remote robot capabilities (loco-manipulation, sensing, robust control, etc.); and (iii) Communication to allow seamless, high-bandwidth, low-latency, bi-directional exchange of information, in relation to real-time teleoperation.

This Research Topic will explore and understand how recent advances in these three domains can create a step-change in telerobotics in demanding and/or dangerous environments. The goal is to capture, not only the progress in operator situational awareness in teleoperation but also the enhancements in robot capabilities with respect to operating in high-risk environments.

To achieve this goal, the Research Topic will showcase recent developments that improve operator performance in telerobotics through the use of mixed reality interfaces, immersive haptic teleoperation, and multimodal sensory feedback. At the same time, the advancements in robot design, control, and sensing capabilities for executing tasks in harsh environments will be highlighted. The novel use of cloud

robotics and advanced communication infrastructures will further demonstrate the full potential of telerobotic systems in the real world.

Topics of interest include, but are not limited to, the following:

- Mixed reality interfaces for telerobotics
- Haptic teleoperation in real-world tasks
- Advanced Tele-locomotion on difficult terrain
- Multimodal sensory perception (visual, haptic, acoustic, others)
- Robot design and control for harsh environments
- AI, perception, and scene understanding in dirty and cluttered environments
- Dexterous telemanipulation in cluttered spaces
- Shared autonomy and interactive learning in remote human-robot interaction

II. Key Dates

- 14 May 2021: Submission deadline
- 14 June 2021: First Reviews Due
- 14 July 2021: Revised Manuscript Due
- 14 August 2021: Final Decision

III. Guest Editors

- Nikhil Deshpande, Italian Institute of Technology, Italy
- Jinoh Lee, Helmholtz Association of German Research Centers, Germany
- Fei Chen, Italian Institute of Technology, Italy
- Kenjiro TADAKUMA, Tohoku University, Japan

IEEE Robotics and Automation Letter

Special Issue on Learning and Control for Robot Compliant Manipulation with Human in the Loop Motivation

I. Introduction

This Special Issue is motivated by recent developments of robotic control methods, learning algorithms and relevant technologies for compliant manipulation. A large number of researchers have reported their significant contributions to this topic. However, there lacks a Special Issue of any relevant journal concentrating on this interesting topic. We believe that the cognitive and learning abilities as well as intelligent control methods are very important in the development of the next generation of robots of compliant manipulation, and therefore deserve to be studied and discussed in a dedicated special issue.

Topics of interest include, but are not limited to, the following:

- Dynamic environment estimation and prediction
- Machine learning-based compliant skill acquirement
- Imitation learning and applications to robot compliant manipulation
- Intelligent control design for robot compliant manipulation
- Physical human robot compliant interaction
- Optimization of human robot collaboration for compliant manufacturing automation.
- Safety for human in the loop robot manipulation in flexible/agile

II. Key Dates

- 16 Sep 2021: Papercept open for submission
- 01 Oct 2021: Submission deadline
- 26 Dec 2021: Authors receive RA-L reviews and recommendation
- 09 Jan 2022: Authors of accepted MS submit final RA-L version
- 25 Jan 2022: Authors of R&R MS resubmit revised MS
- 01 Mar 2022: Authors receive final RA-L decision
- 15 Mar 2022: Authors submit final RA-L files
- 20 Mar 2022: Camera ready version appears in RA-L on Xplore
- 30 Mar 2022: Final Publication

III. Guest Editors

- Chenguang Yang, Bristol Robotics Laboratory, UWE Bristol, UK, Email: cyang@ieee.org
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- Andrea M. Zanchettin, Politecnico di Milano, Italy, Email: andreamaria.zanchettin@polimi.it
- Julie A. Shah, Massachusetts Institute of Technology, USA, Email: julie_a_shah@csail.mit.edu

IEEE Robotics and Automation Letters

Special Issue on Robotic Handling of Deformable Objects

I. Motivation

There is a growing interest in the robotics community to investigate the handling of deformable objects. The ability to interact with deformable objects promises new applications for robots: cable assembly in industrial settings, doing laundry in households, dressing assistance in elderly care, organs and tissues manipulation in surgical operations, or fragile samples collection in underwater/space robotics, to name a few. However, deformable objects are considerably more complex to deal with than rigid ones. Specifically, some of the new challenges involved in handling object deformation are the following:

- The difficulty of sensing the deformation,
- The infinite degrees of freedom of the deformation configuration,
- The complexity of the high nonlinearity in modeling the deformation.

As a result, there is a necessity for novel methodological and technological approaches in this field, and these advances need to cover the full spectrum of robotic problems and tasks (perception, modeling, planning, and control).

Therefore, the aim of this special issue is to collect the latest research results that handle deformable objects in various robotic applications.

II. List of topics

Topics of interest for this special issue include and are not limited to:

- Sensing (e.g., vision, tactile) of deformable objects
- Robotic manipulation of deformable objects (planning, control, grasping, grippers design, etc.)
- Modeling of deformable objects for robotic handling
- Multi-robot and human-robot handling of deformable objects
- Benchmarking robotic handling of deformable objects
- Robot learning for handling deformable objects
- Mobile manipulation of deformable objects (with legged, wheeled, aerial or underwater robots)

III. Time lines

The special issue will follow the following timeline:

- 23 June 2021: Call for Papers
- 23 Sept 2021: Papercept open for submission
- 08 Oct 2021: Submission deadline
- 02 Jan 2022: Authors receive RA-L reviews and recommendation
- 16 Jan 2022: Authors of accepted MS submit final RA-L version
- 01 Feb 2022: Authors of R&R MS resubmit revised MS
- 08 Mar 2022: Authors receive final RA-L decision
- 22 Mar 2022: Authors submit final RA-L files
- 27 Mar 2022: Camera ready version appears in RA-L on Xplore
- 06 April 2022: Final Publication

IV. Guest Editors

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HOTEL & TRANSPORTATION

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Conference Venue

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Transportation

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Taxis are easily available at Chongqing Jiangbei International Airport.

The journey to and from the hotel is approximately 35 minutes, and costs

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Shuttle bus K01 can be found on the ground floor of the airport's T2A, T2B and T3 terminals, and get off at Damiao station. The bus fare is RMB 15.

- **Metro**

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