ICAROB 2022

PROCEEDINGS OF THE 2022 INTERNATIONAL CONFERENCE ON ARTIFICIAL LIFE AND ROBOTICS

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27th AROB International Meeting Series

ARTIFICIAL LIFE AND ROBOTICS

(ICAROB2022)

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HISTORY

The International Conference on Artificial Life and Robotics (ICAROB) resulted from the AROB-symposium (International Symposium on Artificial Life and Robotics) whose first edition was held in 1996 and the eighteenth and last edition in 2013. The AROB symposium was annually organized by Oita University and ALife Robotics Corporation Ltd., under the sponsorship of the Science and Technology Policy Bureau, the Ministry of Education, Science, Sports, and Culture (Monbusho), presently, the Ministry of Education, Culture, Sports, Science, and Technology (Monkasho), Japanese Government, Japan Society for the Promotion of Science (JSPS), the Commemorative Organization for the Japan World Exposition ('70), Air Force Office of Scientific Research, Asian Office of Aerospace Research and Development (AFOSR/AOARD), USA. I would like to express my sincere thanks to not only Monkasho (annually fund support from 1996 to 2013) but also JSPS, the Commemorative

Organization for the Japan World Exposition ('70), and various other Japanese companies for their repeated support. The old symposium (this symposium has been held every year at B-Con Plaza, Beppu, Oita, Japan except in Oita, Japan (AROB 5th '00) and in Tokyo, Japan (AROB 6th '01).) was organized by the International Organizing Committee of AROB and was co-operated by the Santa Fe Institute (USA), RSJ, IEEJ, ICASE (Now ICROS) (Korea), CAAI (P. R. China), ISCIE, IEICE, IEEE (Japan Council), JARA, and SICE. The old AROB-symposium expanded much by absorbing much new knowledge and technologies into it. This history and character of the former AROB symposiums are passed on the current ICAROB conference and to these journals, Journal of Robotics, Networking and Artificial Life (JRNAL) & Journal of Advances in Artificial Life Robotics (JAALR). From now on, ALife Robotics Corporation Ltd. is in charge of management of both the conference and the journals. The future of the ICAROB is brilliant from a point of view of yielding new technologies to human society in the 21st century. We also expect to establish an international research institute on Artificial Life and Robotics in the future with the help of Japanese Government and ICAROB. This conference invites you all.

AIMS AND SCOPE

The objective of this conference is the development of new technologies for artificial life and robotics which have been recently born in Japan and are expected to be applied in various fields. This conference presents original technical papers and authoritative state-of-the-art reviews on the development of new technologies concerning robotics, networking and artificial life and, especially computer-based simulation and hardware for the twenty-first century. This conference covers a broad multidisciplinary field, including areas such as:

Artificial intelligence & complexity
Artificial living
Artificial mind research
Artificial nervous systems for robots
Artificial sciences
Bipedal robot
Brain science and computing
Chaos
Cognitive science
Computational Molecular biology
Computer graphics
Data mining
Disasters robotics
DNA computing
Empirical research on network and MOT
Environment navigation and localization
Evolutionary computations
Facial expression analysis, music recommendation and augmented reality
Foundation of computation and its application

Fuzzy control
Genetic algorithms
Human-welfare robotics
Image processing
Insect-like aero vehicles
Intelligence in biological systems
Intelligent control
Management of technology
Medical surgical robot
Micro-machines
Multi-agent systems
Nano-biology
Nano-robotics
Networking
Neural circuits
Neuro-computer
Neuromorphic Systems
Neuroscience
Pattern recognition
Quantum computing
Reinforcement learning system & genetic programing
Robotics
Software development support method
System cybernetics
Unmanned underwater vehicles
Unmanned Aerial Systems Technologies
Unmanned Aerial Systems designing, controls and navigation
Unmanned Aero vehicles
Virtual reality
Visualization
Hardware-oriented submissions are particularly welcome. This conference will discuss new results in the field of artificial life and robotics

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MESSAGES

Masanori Sugisaka

General Chair of ICAROB

Masanori Sugisaka
General Chair
(President, ALife Robotics Co., Ltd., Japan)
(Visiting Professor, The Open University, UK)

It is my great honor to invite you all to The 2022 International Conference on Artificial Life and Robotics (ICAROB 2022). This Conference is changed as the old symposium from the first (1996) to the Eighteenth (2013) annually which were organized by Oita University and ALife Robotics Corporation Ltd. under the sponsorship of the Science and Technology Policy Bureau, the Ministry of Education, Science, Sports, and Culture (Monbusho), presently, the Ministry of Education, Culture, Sports, Science, and Technology (Monkasho), Japanese Government, Japan Society for the Promotion of Science (JSPS), The Commemorative Organization for the Japan World Exposition ('70), Air Force Office of Scientific Research, Asian Office of Aerospace Research and Development (AFOSR/AOARD), USA. I would like to express my sincere thanks to not only Monkasho (annually fund support from 1996 to 2013) but also JSPS, the Commemorative Organization for the Japan World Exposition ('70), Japanese companies for their repeated support.

The old symposium was organized by International Organizing Committee of AROB and was co-operated by the Santa Fe Institute (USA), RSJ, IEEJ, ICASE (Now ICROS) (Korea), CAAI (P. R. China), ISCIE, IEICE, IEEE (Japan Council), JARA, and SICE. The old AROB symposium was growing up by absorbing many new knowledge and technologies into it. This history and character was inherited also from ICAROB2014(The 2014 International Conference on Artificial Life and Robotics, included a series of ICAROB proceedings in SCOPUS and CPCI-Web of Science now. From now on, ALife Robotics Corporation Ltd. is in charge of management. This year we have The 2022 International Conference on Artificial Life and Robotics (ICAROB2022) (27th AROB Anniversary). The future of The ICAROB is brilliant from a point of view of yielding new technologies to human society in 21st century. I have founded Robot Artificial Life Society in 2017/12/07 together with Professor at Hiroshima University Takao Ito and Professor at University of Miyazaki Makoto Sakamoto. I hope that fruitful discussions and exchange of ideas between researchers during Conference (ICAROB2022) will yield new merged technologies for happiness of human beings and, hence, will facilitate the establishment of an international joint research institute on Artificial Life and Robotics in future.

Yingmin Jia

Co-General Chair of ICAROB

Yingmin Jia
Co-General Chair
(Professor, Beihang University,
R .P. China)

It is my great pleasure to invite you to The 2022 International Conference on Artificial Life and Robotics (ICAROB 2022), Oita, Japan, January 20-23, 2022. Because of the influence of COVID-19, The ICAROB2022 will be held on-line again, and your understanding and support will be the biggest driving force for us to organize the meeting well.

ICAROB develops from the AROB that was created in 1996 by Prof. Masanori Sugisaka and will celebrate her 27th birthday in 2022. So far many important results have been presented at the past meetings and have a profound impact on artificial life and robotics. Doubtless, it is really one of the most famous international conferences in the field of artificial intelligence and attract wide interests among scientist, researchers, and engineers around the world.

For a successful meeting, many people have contributed their great efforts to the ICAROB. Here, I would like to express my special thanks to all authors and speakers, and the meeting organizing team for their excellent works. Looking forward to seeing you at the ICAROB2022.

Takao Ito

Co General Chair of ICAROB

Takao Ito
Co-General Chair
(Professor Hiroshima
University, Japan)

It is my great honor to invite you all to the 2022 International Conference on Artificial Life and Robotics (ICAROB 2022) which will be held online from January 20 to 23, 2022.

The ICAROB has its long history. First launched in 1996 as ISAROB, this former organization of ICAROB, was developed under the strong leadership and yeoman efforts of the President—the internationally famous Professor Masanori Sugisaka, who is widely acknowledged as the father of our AROB conference. Our conference has brought together many research scholars, faculty members, and graduate students from all over the world, and published many manuscripts in high-quality proceedings as well as highly reputed journals every year.

Over the years, dramatic improvements have been made in the field of artificial life and its applications. The ICAROB has provided a foundation for unifying the exchange of scientific information on the studies of man-made systems that exhibit the behavioral characteristics of natural living systems, including software, hardware, and wetware. Our conference shapes the development of artificial life, extending our empirical research beyond the territory circumscribed by life-as-we-know-it and into the domain of life-as-it-could–be. It will provide us a good place to present our new research results, innovative ideas, and valuable information about artificial intelligence, complex systems theories, robotics, and management of technology.

This conference is online. I eagerly look forward to personally meeting you in online, during the ICAROB 2022 and to sharing a most pleasant, interesting, and fruitful conference with you. Do come and make this conference a fruitful, productive as well as enjoyable event.

Ju-Jang Lee

Co-General Chair of ICAROB

The First International Conference on Artificial Life and Robotics (ICAROB) was held in Oita City, Oita, Japan from Jan. 11th to 13th, 2014. This year's Conference will be held amidst the high expectation of the increasingly important role of the new interdisciplinary paradigm of science and engineering represented by the field of artificial life and robotics that continuously attracts wide interests among scientist, researchers, and engineers around the globe.

Distinguished researchers and technologists from around the world are looking forward to attending and meeting at ICAROB. ICAROB is becoming the annual excellent forum that represents a unique opportunity for the academic and industrial communities to meet and assess the latest developments in this fast-growing artificial life and robotics field. ICAROB enables them to address new challenges, share solutions, discuss research directions for the future, exchange views and ideas, view the results of applied research, present and discuss the latest development of new technologies and relevant applications.

In addition, ICAROB offers the opportunity of hearing the opinions of well-known leading experts in the field through the keynote sessions, provides the bases for regional and international collaborative research, and enables to foresee the future evolution of new scientific paradigms and theories contributed by the field of artificial life and robotics and associated research area. The twenty-first century will become the century of artificial life and intelligent machines in support of humankind and ICAROB is contributing through wide technical topics of interest that support this direction.

It is a great honor for me as a Co-General Chair of the 9th ICAROB 2022 to welcome everyone to this important event. Also, I would like to extend my special thanks to all authors and speakers for contributing their research works, the participants, and the organizing team of the 9th ICAROB.

I'm looking forward to meeting you at the 9th ICAROB in on line and wishing you all the best.

Ju-Jang Lee
Co-General Chair
(Honorary professor, KAIST)

GENERAL SESSION TOPICS

GS1 Control System Applications (6)	GS2 Learning Methods (5)
GS3 Robotics (3)	GS4 Applications (3)

ORGANIZED SESSION TOPICS

OS1 Advanced Information Processing Applications (4)	OS2 Advanced studies of interdisciplinary approach (4)
OS3 Intelligent Systems and Robotics-1 (6)	OS4 Intelligent Systems and Robotics -2- (5)
OS5 Intelligent Control (5)	OS6 Bio-inspired Artificial Vision -Systems and Applications- (5)
OS7 Media Information Processing, Music Recommendation and Artificial Intelligence (4)	OS8 Intelligent Systems and Robotics -3- (4)
OS9 Robot Control (10)	OS10 Software Development Support Method (4)
OS11 Applications of deep learning algorithms (9)	OS12 Intelligent Measurements and Control Systems (8)
OS13 Mathematical Informatics (5)	OS14 Biomedical Systems (4)
OS15 Artificial Intelligence for Embedded Systems and Robotics (5)	OS16 Robotic Manipulation (4)
OS17 Advanced Robotics (8)	OS18 Natural Computing (3)
OS19 Industrial Artificial Intelligence Robotics (7)	OS20 Application studies on sensor and RFID system (6)
OS21 Visual Signal Processing and Human-welfare Robotics I&II (6)	OS22 Advanced studies of network engineering (4)
OS23 Applications in Complex Systems (7)	OS24 Artificial Systems and Life (5)
OS25 Information Applications and Cybersecurity (6)	OS26 Intelligent Life and Data Analysis (6)
OS27 Environmental Monitoring (5)	OS28 Robot Competitions and Education (6)
OS29 Advances in Marine Robotics and Their Applications (8)	OS30 Intelligent Systems and Robotics -4- (6)
OS31 Approaches to Post-Narratology that Combines AI and Cognitive Science with Narratology (9)	OS32 Human-Machine Interface and Automation (9)
OS33 Signal Processing and Chaotic System (5)	OS34 Robotics Navigation and Control (3)

TIME TABLE (1/20)   in Japan time

1/20(Thu.)	All Rooms meeting passcode(全部屋のミーティングのパスコードは 2022) is 2022 Group meeting for the conference (Conference Room ZOOM ID: 867 9702 9629)
1/23(Sun)	Group meeting for the next conference (Conference Room ZOOM ID: 867 9702 9629)

TIME TABLE (1/21)

1/21(Fri.)	Meeting Room 1 (ZOOM ID: 880 7966 0454)	Meeting Room 2 (ZOOM ID: 893 6690 0965)	Meeting Room 3 (ZOOM ID: 816 1412 9634)	Meeting Room 4 (ZOOM ID: 882 7162 1954)
8:40-	Registration			
9:00-10:00	OS1 Advanced Information Processing Applications (4) Chair: Toru Hiraoka	OS22 Advanced studies of network engineering (4) Chair: Wei Hong Lim	OS23 Applications in Complex Systems (7) Chair: Masao Kubo Will be end at 10:45	OS34 Robotics Navigation and Control (3) Chair: Jiwu Wang
10:00-10:20	Coffee break			
10:20-10:50	Chair : Sakamoto Makoto Opening Ceremony (Conference Room ZOOM ID: 867 9702 9629)			
11:00-12:00	Chair : Yingmin Jia (Conference Room ZOOM ID: 867 9702 9629) Plenary Speech PS2 H. Yamamoto			
12:00-13:00	Lunch			
13:00-14:00	OS2 Advanced studies of interdisciplinary approach (4) Chair: Yousin Park	OS10 Software Development Support Method (4) Chair: Tetsuro Katayama	OS14 Biomedical Systems (4) Chair: Taro Shibanoki	OS16 Robotic Manipulation (4) Chair: Kensuke Harada
14:00-14:20	Coffee break			
14:20-15:50	OS4 Intelligent Systems and Robotics -2- (5) chair: Haokang Wen OS30 Intelligent Systems and Robotics -4- (6) chair: Jichao Zhao OS33 Signal Processing and Chaotic System (5) chair: Huailin Zhao	GS3 Robotics (3) GS4 Applications (3) GS3 Chair: Hideyuki Tanaka GS4 Chair: Noritaka Sato	OS25 Information Applications and Cybersecurity (6) Chair: I-Hsien Liu	OS28 Robot Competitions and Education (6) Chair: Kazuo Ishii
15:50-16:10	coffee break			
16:10-17:10	Chair: Kazuo Ishii (Conference Room ZOOM ID: 867 9702 9629) Plenary Speech PS1 Henrik Hautop Lund			
17:10-17:30	Coffee break			

17:30-18:30	Chair: Rishav Bose & Luigi Pagliarini (Conference Room) Invited Speech IS1, IS2 Luigi Pagliarini, Rishav Bose			

TIME TEBLE (1/22)

1/22(Sat.)	Meeting Room 1 (ZOOM ID: 880 7966 0454)	Meeting Room 2 (ZOOM ID: 893 6690 0965)	Meeting Room 3 (ZOOM ID: 816 1412 9634)	Meeting Room 4 (ZOOM ID: 882 7162 1954)
8:40-	Registration			
9:00-10:30	OS13 Mathematical Informatics (5) Chair: Takao Ito	OS6 Bio-inspired Artificial Vision – Systems and Applications- (5) Chair: Shinsuke Yasukawa	OS15 Artificial Intelligence for Embedded Systems and Robotics (5) Chair: Hakaru Tamukoh	GS1 Control System Applications (6) Chair: Hiroaki Wagatsuma
10:30-10:45	Coffee break			
10:45-12:00	OS5 Intelligent Control (5) Chair: Yingmin Jia	GS2 Learning Methods (5) Chair: Masato Nagayoshi	OS24 Artificial Systems and Life (5) Chair: Kuo-Hsien Hsia	OS27 Environmental Monitoring (5) Chair: Kazuo Ishii
12:00-13:00	Lunch			
13:00-14:00	Chair : Eiji Hayashi (Conference Room ZOOM ID: 867 9702 9629) Plenary Speech PS3 Takao Ito			
14:00-14:20	Coffee break			
14:20-15:20	OS21-1 Visual Signal Processing and Human-welfare Robotics I&II (4) Chair: Joo Kooi Tan	OS19-1 Industrial Artificial Intelligence Robotics (4) Chair: Eiji Hayashi	OS26-1 Intelligent Life and Data Analysis (4) Chair: I-Hsien Liu	OS29-1 Advances in Marine Robotics and Their Applications (4) chair: Keisuke Watanabe
15:20-15:30	Coffee break			
15:30-16:30	OS21-2 Visual Signal Processing and Human-welfare Robotics I&II (2) Chair: Joo Kooi Tan	OS19-2 Industrial Artificial Intelligence Robotics (3) Chair: Eiji Hayashi	OS26-2 Intelligent Life and Data Analysis (2) Chair: I-Hsien Liu	OS29-2 Advances in Marine Robotics and Their Applications (4) chair: Keisuke Watanabe
16:30-16:40	Coffee break			
16:40-17:40	OS11-1 Applications of deep learning Algorithms (4) Chair: Xiaoyan Chen	OS18 Natural Computing (3) Chair: Marion Oswald	OS17-1 Advanced Robotics (4) Chair: Evgeni Magid	
17:40-17:50	Coffee break			
17:50-19:05	OS11-2 Applications of deep learning Algorithms (5) Chair: Xiaoyan Chen		OS17-2 Advanced Robotics (4) Chair: Evgeni Magid	

TIME TABLE (1/23)

1/23(Sun.)	Meeting Room 1 (ZOOM ID: 880 7966 0454)	Meeting Room 2 (ZOOM ID: 893 6690 0965)	Meeting Room 3 (ZOOM ID: 816 1412 9634)	Meeting Room 4 (ZOOM ID: 882 7162 1954)
8:40-	Registration			
9:00-10:30	OS3 Intelligent Systems and Robotics-1 (6) chair: Peng Lu OS8 Intelligent Systems and Robotics -3- (4) chair: Tianyi Zhang		OS9-1 Robot Control (6) Chair: Yizhun Peng	OS31 Approaches to Post-Narratology that Combines AI and Cognitive Science with Narratology (6) Chair: Jumpei Ono
10:30-10:50	Coffee break			
10:50-11:50		OS7 Media Information Processing, Music Recommendation and Artificial Intelligence (4) Chair: Yasunari Yoshitomi	OS9-2 Robot Control (4) Chair: Yizhun Peng	OS31-2 Approaches to Post-Narratology (3) that Combines AI and Cognitive Science with Narratology (3) Chair: Jumpei Ono
11:50-13:00	Lunch			
13:00-14:00		OS20-1 Application studies on sensor and RFID system (4) chair: Ammar A.M. Al-Talib	OS32-1 Human-Machine Interface and Automation (4) Chair: Norrima Mokhtar	OS12-1 Intelligent Measurements and Control Systems (4) Chair: Xiaoyan Chen
14:00-14:10	Coffee break			
14:10-15:25		OS20-2 Application studies on sensor and RFID system (2) chair: Ammar A.M. Al-Talib	OS32-2 Human-Machine Interface and Automation (5) Chair: Norrima Mokhtar	OS12-2 Intelligent Measurements and Control Systems (4) Chair: Xiaoyan Chen

The 2022 International Conference on ARTIFICIAL LIFE AND ROBOTICS (ICAROB2022)

January 20 (Thursday)

17:30-19:30

Group meeting for the conference

January 21 (Friday)

10:20-10:50

Opening Ceremony
Chair: Sakamoto Makoto (University of Miyazaki, Japan)

Welcome Addresses

1. **General Chairman of ICAROB**   Masanori Sugisaka (ALife Robotics Co., Ltd., Japan)
2. **Co-General Chairman of ICAROB**   Yingmin Jia (Beihang University, China)
3. **Co-General Chairman of ICAROB**   TaKao Ito (Hiroshima University, Japan)
4. **Co-General Chairman of ICAROB**   Ju-Jang Lee (KAIST, Korea)

January 23 (Sunday)

15:30-17:30
Group meeting for the next conference

TECHNICAL PAPER INDEX

January 21 (Friday)
8:40-Registration

Conference Room
10:20-10:50 Opening Ceremony
Chair: Sakamoto Makoto (University of Miyazaki, Japan)

11:00-12:00
Plenary Speech PS2
Chair: Yingmin Jia (Beihang University, China)

PS2 *Road To Cyber Physical Factory (Application Examples of Intelligent Factory and its Technology)*
Hidehiko Yamamoto (Gifu University, Japan)

16:10-17:10
Plenary Speech PS1
Chair: Kazuo Ishii (Kyushu Institute of Technology, Japan)

PS1 *Robotics for Growing Life*
Henrik Hautop Lund (Technical University of Denmark, Denmark)

17:30-18:00
Invited Speech IS1
Chair: Rishav Bose (Technical University of Denmark, Denmark)

IS1-1 *A physical to virtual control system implementing an art-based game*
IS1-2 *Creative Multisensory Environments*
Luigi Pagliarini (Technical University of Denmark, Denmark, Academy of Fine Arts of Macerata, Italy)

18:00-18:30
Invited Speech IS2
Chair: Luigi Pagliarini
(Technical University of Denmark, Denmark, Academy of Fine Arts of Macerata, Italy)

IS2-1 *Using GrowBots to Study Heat and Nutrient Stress in Basil*
IS2-2 *Convolutional Neural Network for Studying Plant Nutrient Deficiencies*
Rishav Bose (Technical University of Denmark, Denmark)

Meeting Room 1
9:00-10:00 OS1 Advanced Information Processing Applications (4)
Chair: Toru Hiraoka (University of Nagasaki, Japan)
Co-Chair: Masaharu Hirota (Okayama University of Science, Japan)

OS1-1 *Generation of Checkered Pattern Images Using Prewitt Filter from RGB-D Images*
Toru Hiraoka, Ryosuke Takaki (University of Nagasaki, Japan)

OS1-2 *An Approach of Analyzing Movement Patterns Using Word Embeddings from Geo-tagged Tweets*
Masaharu Hirota, Tetsuya Oda (Okayama University of Science, Japan)

OS1-3 *A Proposal of a Software Defect Predication System Using SOM*
Yoshihiro Kita[1], Kazuki Ueda[2], Kiyotaka Sakurai[2]
([1]University of Nagasaki, [2]Nihon Knowledge Co. Ltd, Japan)

OS1-4 *Mapping the Motion of Highly-inclined Triple System into a Secular Perturbation Model*
Masaya M. Saito (University of Nagasaki, Japan)
Kiyotaka Tanikawa (National Astronomical Observatory, Japan)

13:00-14:00 OS2 Advanced studies of interdisciplinary approach (4)
Chair: Yousin Park (Prefectural University of Hiroshima, Japan)
Co-Chair：Takao Ito (Hiroshima University, Japan)

OS2-1 *Measuring the entire degree centrality in Yokokai*
Tsutomu Ito[1], Matsuno Seigo[1], Sakamoto Makoto[2], Takao Ito[3]
([1]Ube National College of Technology, Japan) ([2]Univeristy of Miyazaki, Japan)
([3]Hiroshima University, Japan)

OS2-2 *A comparative study on Michinoeki's efficiency in Japan*
Tsutomu Ito[1], Matsuno Seigo[1], Sakamoto Makoto[2], Takao Ito[3]
([1]Ube National College of Technology, Japan) ([2]Univeristy of Miyazaki, Japan)
([3]Hiroshima University, Japan)

OS2-3 *The R&D Direction and Business Strategy: The case study on the cooperation of EV and battery makers*
Yousin Park[1], Iori Nakaoka[2], Yun-ju Chen[3]
([1]Prefectural University of Hiroshima, Japan) ([2]Seijoh University, Japan)
([3]Shiga University, Japan)

OS2-4 *Discovering the relationship between tourists and tourist spots in Japan*
Tsutomu Ito[1], Matsuno Seigo[1], Sakamoto Makoto[2], Takao Ito[3]
([1]Ube National College of Technology, Japan) ([2]Univeristy of Miyazaki, Japan)
([3]Hiroshima University, Japan)

**14:20-15:50 OS4 Intelligent Systems and Robotics -2- & OS30 Intelligent Systems and Robotics -4-
& OS33 Signal Processing and Chaotic System**

OS4 Intelligent Systems and Robotics -2- (5)
Chair: Haokang Wen (Tianjin University of Science and Technology, China)
Co-Chair: Jiaxin Li (Tianjin University of Science and Technology, China)

OS4-1 *A Research on Image Dehazing Technology for Image Enhancement*
Haokang Wen, Chang Sheng (Tianjin University of Science and Technology, China,)

OS4-2 *Design of Intelligent Daylily Picking Robot*
Jiaxin Li (Tianjin University of Science and Technology, China)

OS4-3 *50KN Compression Spring Fatigue Testing Machine Design*
Peng Lu, Peng Jia (Tianjin University of Science and Technology, China)

OS4-4 *New Intelligent Unmanned Retail Shopping Container Design*
Peng Lu, Yiting Gao (Tianjin University of Science and Technology, Tianjin, China)

OS4-5 *Java-based Dream Cloud ERP System - Inventory Management Subsystem Design
and Implementation*
Yiting Gao, Peng Lu (Tianjin University of Science and Technology, China)

OS30 Intelligent Systems and Robotics -4- (6)
Chair Jichao Zhao (Tianjin University of Science and Technology, China)
Co-Chair Hucheng Wang (Tianjin University of Science and Technology, China)

OS30-1 *A Design of Micromouse Control System*
Hucheng Wang (Tianjin University of Science and Technology, China)

OS30-2 *A Driver Reaction Time Detection System Design*
Yuhui Cheng[1], Mochi Li[2] ([1] Tianjin University of Science and Technology, China)
([2] Ocean University of China, China)

OS30-3 *A PID Tracking Car Design based on STM32*
Yande Xiang, Teng Zhang, Shixiang Zhao, Ling Zhou, Mingjuan Tian, Haoran Gong
(Tianjin University of Science and Technology, China)

OS30-4 *Matrix Approach to Current-state Detectability of Discrete-event Systems*
Jinliang Wang, Jiawei Wei, Xiaoguang Han
(Tianjin University of Science and Technology, China)

OS30-5 *Hardware Circuit Design Of Tracking Car Based On K60*
Peng Jia, Yande Xiang (Tianjin University of Science and Technology, China)

OS30-6   *Detachable IoT Garbage Sorting Device Based on Machine Vision*
Tao Zhu, Yang Su, Zhiqing Xiao, Fengzhi Dai
(Tianjin University of Science and Technology, China)

OS33 Signal Processing and Chaotic System (5)
Chair: Huailin Zhao (Shanghai Institute of Technology, China)
Co-Chair: Fengzhin Dai (Tianjin University of Science and technology, China)

OS33-1   *A Visual Measurement Algorithm of Approaching Vehicle Speed Based on Deep Learning*
Yurong Zhu, Huailin Zhao, Liu Junjie, Zhang Jinping, Ji Xiaojun
(Shanghai Institute of Technology, China)

OS33-2   *Target Search Based on Scene Priors*
Shengyang Lu, Lanjun Liang, Huailin Zhao, Fangbo Zhou, Feng yao
(Shanghai Institute of Technology, China)

OS33-3   *A Generalized Hamiltonian Conservative Systems with Multi-scroll Chaotic Flows*
Jingwen Liu, Zhonggao Chen (Tianjin University of Science and Technology, China)

OS33-4   *Multi-stability and FPGA Implementation of a Conservative Chaotic System*
Minghan Song (Tianjin University of Science and Technology, China)

OS33-5   *A New Hyperchaotic Financial System*
Lei Gong (Tianjin University of Science and Technology, China)

Meeting Room 2
9:00-10:00 OS22 Advanced studies of network engineering (4)
Chair Wei Hong Lim (UCSI University, Malaysia)
Co-Chair Takao Ito (Hiroshima University, Japan)

OS22-1   *New Hybridization Algorithm of Differential Evolution and Particle Swarm Optimization for Efficient Feature Selection*
Koon Meng Ang, Mohd Rizon Bin Mohamed Juhari, Wei Hong Lim, Sew Sun Tiang, Chun Kit Ang, Eryana Eiyda Hussin, Li Pan, Ting Hui Chong
(UCSI University, Malaysia)

OS22-2   *River Water Quality Monitoring Through LoRa Network*
Syarifah Nabilah Syed Taha Tahir, Mohamad Sofian Abu Talip, Mahazani Mohamad, Mohamadariff Othman, Tengku Faiz Tengku Mohmed Noor Izam, Mohd Faiz Mohd Salleh, Zati Hakim Azizul Hasan, Zeeda Fatimah Mohamad, Amir Feisal Merican Aljunid Merican (Universiti Malaya, Malaysia)

OS22-3   *Wideband Antenna with UHF Sensor Applicability for MV/HV Equipment in Smart-Grid Systems*
S. M. Kayser Azam[1], Mohamadariff Bin Othman[1], Tarik Abdul Latef[1], H. A. Illias[1], Mohd Fadzil Ain[2], Yazeed Qasaymeh[3] ([1]Universiti Malaya, Malaysia)
([2]Universiti Sains Malaysia, Malaysia) ([3]Majmaah University, Saudi Arabia)

OS22-4   *New Particle Swarm Optimization Variant with Modified Neighborhood Structure*
Koon Meng Ang[1], Mohd Rizon Bin Mohamed Juhari[1], Wy-Liang Cheng[1], Wei Hong Lim[1]*, Sew Sun Tiang[1], Chin Hong Wong[2], Hameedur Rahman[3], Li Pan[1]
([1]UCSI University, Malaysia) ([2]Fuzhou University, China)
([3]Air University, Islamabad, Pakistan)

13:00-14:00 OS10 Software Development Support Method (4)
Chair: Tetsuro Katayama (University of Miyazaki, Japan)
Co-Chair: Tomohiko Takagi (Kagawa University, Japan)

OS10-1   *N-Switch and All-Path Test Coverage Criterion for Extended Finite State Machine*
Tomohiko Takagi[1], Koichiro Sakata[1], Kouichi Akiyama[2]
([1]Kagawa University, Japan), ([2]Japan WillTech Solution Co., Ltd., Japan)

OS10-2   *Proposal of a Method to Generate Classes and Instance Variable Definitions in the VDM++ Specification from Natural Language Specification*
Kensuke Suga[1], Tetsuro Katayama[1], Yoshihiro Kita[2], Hisaaki Yamaba[1], Kentaro Aburada[1], Naonobu Okazaki[1]
([1]University of Miyazaki, Japan), ([2]University of Nagasaki, Japan)

OS10-3   *Expansion of Application Scope and Addition of a Function for Operations into BWDM to Generate Test Cases from VDM++ Specification*
Takafumi Muto[1], Tetsuro Katayama[1], Yoshihiro Kita[2],
Hisaaki Yamaba[1], Kentaro Aburada[1], Naonobu Okazaki[1]
([1]University of Miyazaki, Japan), ([2]University of Nagasaki, Japan)

OS10-4   *Proposal of Gamma which is a spatial data sharing distributed MQTT system*
Takahiro Ueda[1], Tetsuro Katayama[1], Yoshihiro Kita[2], Hisaaki Yamaba[1], Kentaro Aburada[1], Naonobu Okazaki[1]
([1]University of Miyazaki, Japan), ([2]University of Nagasaki, Japan)

14:20-15:50 GS3 Robotics & GS4 Applications
GS3 Robotics (3)

GS3-1　*A Three-Dimensional Design of the Multi-material Joint System to Realize a Structural Spring-Damper Compliant Mechanism with Versatility in Engineering Fields*
Pancho Dachkinov[1], Anirudha Bhattacharjee[2], Bishakh Bhattacharya[2], Hiroaki Wagatsuma[1,3]
([1]Kyushu Institute of Technology, Japan; [2]Indian Institute of Technology Kanpur, India; [3]RIKEN CBS, Japan)

GS3-2　*Haptic Device that Presents Sensation Corresponding to Palm on Back of Hand*
for Teleoperation of Robot Hand Report 5: Verification of development device specifications
Kyosuke Ushimaru, Noritaka Sato (Nagoya Institute of Technology, Japan)

GS-3-3　*HBV Epidemic Control Using Time-Varying Sliding Mode Control Method*
Arsit Boonyaprapasorn[1], Suwat Kuntanapreeda[2], Parinya Sa Ngaimsunthorn[2],
Thunyaseth Sethaput[3], Tinnakorn Kumsaen[4]
([1]Chulachomklao Royal Military Academy, Thailand)
([2]King Mongkut's University of Technology North Bangkok, Thailand)
([3]Thammasat University, Thailand) ([4]Khon Kaen University, Thailand)

GS4 Applications (3)
Chair: Noritaka Sato (Nagoya Institute of Technology, Japan)

GS4-1　*Blockchain Technology for Halal Supply Chain Management*
Kadeer Zulihuma, Abdul Samad Shibghatullah, Chit Su Mon
(UCSI University, Malaysia)

GS4-2　*Smart Tourism Guide Application Using Location-Based Services – Go.Travel*
Wong Yit Meng, Abdul Samad Bin Shibghatullah, Kasthuri Subaramaniam
(UCSI University, Malaysia)

GS4-3　*Gesturenomy: Touchless Restaurant Menu Using Hand Gesture Recognition*
Ian Christian Susanto, Kasthuri Subaramaniam, Abdul Samad Bin Shibghatullah
(UCSI University, Malaysia)

Meeting Room 3
9:00-10:45 OS23 Applications in Complex Systems (7)
Chair: T Masao Kubo (National Defense Academy, Japan)
Co-Chair: Hiroshi Sato (National Defense Academy, Japan)

OS23-1　*A research of infectivity rate After the Consecutive Holidays*
Saori Iwanaga (Japan Coast Guard Academy, Japan)

OS23-2　*Towards the Trusted Population-Based Optimization Systems*
Hiroshi Sato, Masao Kubo (National Defense Academy, Japan)

OS23-3   *Spatio-temporal prediction of crime occurrence spots by CNN-LSTM*
Kaede Yaji, Masao Kubo, Hiroshi Sato (National Defense Academy, Japan)

OS23-4   *Cross-View Image Geo-Localization using Multi-Scale Generalized Pooling with Attention Mechanism*
Duc Viet Bui, Masao Kubo, Hiroshi Sato (National Defense Academy, Japan)

OS23-5   *Recommendation a Emergency Patient Destinations by LightGBM*
Ryota Kawaguchi, Masao Kubo, Hiroshi Sato (National Defense Academy, Japan)

OS23-6   *A Framework for Understanding the Neural Underpinnings of Symbolic and Non-Symbolic Communication Based on Global Synchronization in Human Brain Activity*
Masayuki Fujiwara, Takashi Hashimoto (Japan Advanced Institute of Science and Technology, Japan)

OS23-7   *Characterization of randomness tests by using tests results of weakly correlated chaotic sequences*
Akihiro Yamaguchi (Fukuoka Institute of Technology), Asaki Saito (Future University Hakodate, Japan)

13:00-14:00 OS14 Biomedical Systems (4)
Chair: Taro Shibanoki (Okayama University, Japan)

OS14-1   *A Mutual Control Method for a Multi-layered Non-contact Impedance Model-based mobile robots*
Masaru Sasaki[1], Taro Shibanoki[2], Hideyuki Tonooka[1], Toshio Tsuji[3]
([1]Ibaraki University, Japan), ([2]Okayama University, Japan)
([3]Hiroshima University, Japan)

OS14-2   *Relationship Between Delay Time and Sensation in Tactile Feedback for Myoelectric Prosthesis*
Taro Shibanoki (Okayama University, Japan), Kosuke Jin (Ibaraki University, Japan)

OS14-3   *Effects of Tactile Stimulation Near the Auricle on Body Sway During Foot Stamping*
Masaya Tadokoro[1], Taro Shibanoki[2], Hideyuki Tonooka[1]
([1]Ibaraki University, Japan), ([2]Okayama University, Japan)

OS14-4   *A Monitoring System of a Hamster Based on Video Image Analysis*
Yugo Yamazaki[1], Taro Shibanoki[2], Hideyuki Tonooka[1]
([1]Ibaraki University, Japan), ([2]Okayama University, Japan)

14:20-15:50 OS25 Information Applications and Cybersecurity (6)
Chair: I-Hsien Liu (National Cheng Kung University, Taiwan)
Co-Chair: Kuo-Hsien Hsia (National Yunlin University of Science and Technology, Taiwan)

OS25-1   *Extendable ICS Honeypot Design with Modbus/TCP*
I-Hsien Liu, Jun-Hao Lin, Hsin-Yu Lai, Jung-Shian Li (National Cheng Kung University, Taiwan)

OS25-2   *Industrial Control System Cybersecurity Testbed with TSN Feature*
          I-Hsien Liu, Li-Yin Chang, Jung-Shian Li (National Cheng Kung University, Taiwan)
          Chuan-Gang Liu (Chia Nan University of Pharmacy & Science, Taiwan)

OS25-3   *Using the Modified Delphi Method to Construct the Quality Indicators of the Counseling Service
          System*
          Li-Min Chuang, Hsiu-Hao Liu (Chang Jung Christian University, Taiwan)

OS25-4   *The Key Success Factors of Introducing ERP System in Taiwan's Manufacturing Industry*
          Li-Min Chuang, Yu-Po Lee (Chang Jung Christian University, Taiwan)

OS25-5   *The Fuzzy AHP approach for intelligent building assessment model*
          Li-Min Chuang, Yu-Po Lee (Chang Jung Christian University, Taiwan),
          Chien-Chih Kuo (Chien Chang Construction Co., Ltd.)

OS25-6   *Blockchain-based Verification Mechanism for Industrial Control System*
          Yao-Chu Tsai, I-Hsien Liu and Jung-Shian Li (National Cheng Kung University, Taiwan)

Meeting Room 4
9:00-9:45 OS34 Robotics Navigation and Control (3)
Chair: Jiwu Wang (Beijing Jiaotong University, China)
Co-Chair: Shilong Zhen (Beijing Jiaotong University, China)

OS34-1   *Research on Path Planning Algorithms of Multiple Mobile Robots in Intelligent
          Warehousing*
          Jiwu Wang, Shilong Zheng (Beijing Jiaotong University, China)

OS34-2   *Research on the effectiveness of improved ORB depth estimation in monocular
          vision slam*
          Jiwu Wang, Weipeng Wan (Beijing Jiaotong University, China)

OS34-3   *Research on Research on Corner Detection Algorithm Based on Edge Contour in
          Automatic Loading Positioning*
          Jiwu Wang, Junwei Fu (Beijing Jiaotong University, China)

13:00-14:00 OS16 Robotic Manipulation (4)
Chair: Kensuke Harada (Osaka University, Japan)
Co-Chair: Tokuo Tsuji (Kanazawa University, Japan)
Co-Chair: Akira Nakamura (Saitama Institute of Technology, Japan)

OS16-1   *Motion Planning for Retrieving an Object in a Complex Environment*
          Shusei Nagato, Tomohiro Motoda, Keisuke Koyama, Weiwei Wan, Kensuke Harada
          (Osaka University, Japan)

OS16-2　*Design and Control of Two-sided Gripper for Bin Picking*
He Maike, Tokuo Tsuji, Tatsuhiro Hiramitsu, Hiroaki Seki
(Kanazawa University, Japan)

OS16-3　*Training Data Augmentation for Semantic Segmentation of Food Images Using Deep Learning*
Takayuki Yamabe, Tatsuya Ishichi, Tokuo Tsuji, Tatsuhiro Hiramitsu, Hiroaki Seki
(Kanazawa University, Japan)

OS16-4　*Suitable Error Recovery Process using Combined Evaluation Standards in Robotic Manufacturing Plant*
Akira Nakamura[1], Kensuke Harada[2]
([1]Saitama Institute of Technology, [2]Osaka University, Japan)

14:20-15:50 OS28 Robot Competitions and Education (6)

Chair: Kazuo Ishii (Kyushu Institute of Technology, Japan)

Co-Chair: Yasunori Takemura (Nishinippon Institute of Technology, Japan)

OS28-1　*Underwater Acoustic Positioning Based on MEMS Microphone for a Portable Autonomous Underwater Vehicle*
Irmiya R. Inniyaka, Dominic B. Solpico, Daiki Hamada, Akihiro Sugino, Rikuto Tanaka, Yuya Nishida, Kazuo Ishii (Kyushu Institute of Technology, Japan)

OS28-2　*Autonomous Underwater Vehicle with Vision-based Navigation System for Underwater Robot Competition*
Kazuki Harada, Riku Fukuda, Yusuke Mizoguchi, Yusuke Yamamoto, Kouta Mishima, Yoshiki Tanaka, Yuya Nishida, Kazuo Ishii (Kyushu Institute of Technology, Japan)

OS28-3　*Tomato Harvesting in Greenhouse Considering the Effect of Sunlight*
Kai Shioji, Shinsuke Yasukawa, Kazuo Ishii (Kyushu Institute of Technology, Japan)

OS28-4　*Inter-University Collaboration Aimed at Integrating Different Robotic Fields: Development of Underwater Robots and Soccer Robots Through these Competitions*
Moeko Tominaga[1], Jonghyun Ahn[2], Yasunori Takemura[1], Kazuo Ishii[3]
([1]Nishinippon Institute of Technology, Japan, [2]Hiroshima Institute of Technology, Japan, [3]Kyushu Institute of Technology, Japan)

OS28-5　*Exercise on Environmental Monitoring and Control of Greenhouse by IoT Devices toward Smart Agriculture*
Yuya Nishida, Ryugo Mochizuki, Shinsuke Yasukawa, Kazuo Ishii
(Kyushu Institute of Technology, Japan)

OS28-6　　*Evaluation of roller arrangement of sphere by omnidirectional integral value*
[1]Kenji Kimura, [2]Yusuke Abematsu, [3]Hirai Hiroyasu, [3]Kazuo Ishi
([1]Fukuoka Daiichi High School, Japan, [2]Kagoshima Gyokuryu High School, Japan,
[2]Kyushu Institute of Technology, Japan)

January 22 (Saturday)

8:40-Registration

Conference Room
13:00-14:00
Plenary Speech PS3
Chair: Eiji Hayashi (Kyushu Institute of Technology, Japan)

PS3 *Robot Technology, and it's Development Trend–Developing a New Networking Robot System-*
　Takao Ito (Hiroshima University, Japan)

Meeting Room 1
9:00-10:15 OS13 Mathematical Informatics (5)
Chair: Takao Ito (Hiroshima University, Japan)
Co-Chair: Makoto Sakamoto (University of Miyazaki, Japan)

OS13-1　　*Basic Study on Design Tool of Hula Costumes*
Taketo Kamasaka[1], Kodai Miyamoto[1], Makoto Sakamoto[1], Satoshi Ikeda[1], Amane Takei[1], Kenji Aoki[1], Tsutomu Ito[2], Takao Ito[3] ([1]University of Miyazaki, Japan), ([2]National Institute of Technology, Ube College, Japan)
([3]Hiroshima University, Japan)

OS13-2　　*Basic Study on the Use of XR Technology to Support Science Education*
Kodai Miyamoto[1], Taketo Kamasaka[1], Makoto Sakamoto[1], Masahiro Yokomichi[1], Satoshi Ikeda[1], Amane Takei[1], Tsutomu Ito[2], Takao Ito[3]
([1]University of Miyazaki, Japan), ([2]National Institute of Technology, Ube College, Japan), ([3]Hiroshima University, Japan)

OS13-3　　*Analysis of 5x5 board Quoridor*
Takuro Iwanaga, Makoto Sakamoto, Takao Ito, Satoshi Ikeda
(University of Miyazaki, Japan)

OS13-4　　*A perfect play in 4×12 board of Othello*
Tomoyasu Toshimori, Makoto Sakamoto, Takao Ito, Satoshi Ikeda

(University of Miyazaki, Japan)

OS13-5 *Parallel full-wave electromagnetic field analysis based on domain decomposition method*
Amane Takei, Kento Ohnaka, Makoto Sakamoto (University of Miyazaki, Japan)

10:45-12:00 OS5 Intelligent Control (5)
Chair: Yingmin Jia (Beihang University, China)
Co-Chair: Weicun Zhang (University of Science and Technology Beijing, China)

OS5-1 *Geometry Structure Oriented Nonlinear Internal Model Based Manifold Consensus*
Yunzhong Song[1], Weicun Zhang[2], Fengzhi Dai[3], Huimin Xiao[4], Shumin Fei[5]
([1]Henan Polytechnic University, China), ([2]University of Science and Technology Beijing, China)
([3]Tianjin University of Science and Technology, China), ([4]Henan University of Economics and Law, China), ([5]South East University, China)

OS5-2 *Consensus Control of Linear Discrete-time Multi-agent Systems with Limited Communication Data Rate*
Jintao Hu, Yingmin Jia, Yaxin Li (Beihang University, China)

OS5-3 *Formation control for rectangular agents with communication maintenance and collision avoidance*
Yaxin Li, Yingmin Jia, Jintao Hu (Beihang University, China)

OS5-4 *Research on Sign Language Recognition Algorithm Based on Improved R(2+1)D*
Yueqin Sheng[1], Qunpo Liu[1], Naohiko Hanajima[2], Bo Su[1]
([1]Henan Polytechnic University, China), ([2]Muroran Institute of Technology, Japan)

OS5-5 *Directional Flocking of Multi-Agent system Caused by Limited Visual Field*
Yongnan Jia[1], Yong Xie[2], Weicun Zhang[1]
([1]University of Science and Technology Beijing, China)
([2]The System Design Institute of Mechanical-Electrical Engineering, China)

14:20-16:15 OS21 Visual Signal Processing and Human-welfare Robotics I&II (7)
Chair: Joo Kooi Tan (Kyushu Institute of Technology, Japan)
Co-Chair: Nobuo Sakai (Kyushu Institute of Technology, Japan)

OS21-1 *Object Acquisition Based on Human-Robot Cooperation*
Kota Ito, Masuhiro Nitta, Seiji Ishikawa, Joo Kooi Tan
(Kyushu Institute of Technology, Japan)

OS21-2 *Development of Musculoskeletal Walking Simulator for Analysis of Human Walking and Rehabilitation*
Nobuo Sakai, Yukiho Ryu, Tsubasa Ikeda, Mochimitsu Komori (Kyushu Institute of Technology), Masako Fuchi (Kyushu Nutrition Welfare University), Katsuki Hayashi (Seiai Rehabilitation Hospital)

OS21-3   *Collision Avoidance in a Human-Robot Coexistence Food Preparation Environment Using Hands Area Extraction*
Takaaki Yotsumoto, Yuta Ono, Masuhiro Nitta, Joo Kooi Tan
(Kyushu Institute of Technology, Japan)

OS21-4   *Supporting Safe Walk at a Railway Station Platform for a Visually Impaired Person Based on MY VISION*
Yuki Kawaguchi, Seiji Ishikawa, Takashi Shinomiya*, Joo Kooi Tan
(Kyushu Institute of Technology, Japan, *N&N Inc., Japan)

OS21-5   *Detecting a Pedestrian's Walk Direction Using MY VISION for Supporting Safe Walk of a Visually Impaired Person*
Shinya Iizumi, Yuta Ono, Masuhiro Nitta, Seiji Ishikawa, Joo Kooi Tan
(Kyushu Institute of Technology, Japan)

OS21-6   *Fruits and Vegetables detection using the improved YOLOv3*
Changhua Xu, Ziyue Liu, Masuhiro Nitta, Joo Kooi Tan (Kyushu Institute of Technology, Japan)

OS21-7   *Strict frequency estimation of sinusoidal signal using sampling function(withdraw)*
Masuhiro Nitta (Kyushu Institute of Technology, Japan)

16:40-19:05 OS11 Applications of deep learning algorithms (8)
Chair: Xiaoyan Chen (Tianjin University of Science and Technology, China)
Co-Chair: Shiming Wang (Tianjin University of Science and Technology, China)

OS11-1   *Human-vehicle detection based on YOLOv5*
Zhihui Chen[1], Xiaoyan Chen[1], Xiaoning Yan[2], Shuangwu Zheng[2]
([1]Tianjin University of Science and Technology, China)
([2]Shenzhen Softsz Co. Ltd., China)

OS11-2   *Low light enhancement CNN Network based on attention mechanism*
Xiwen liang[1], Xiaoyan Chen[1], Hao Feng[1], Xiaoning Yan[2], Nenghua Xu[2]
([1]Tianjin University of Science and Technology, China)
([2]Shenzhen Softsz Co. Ltd., China)

OS11-3   *Fruit Recognition Based on YOLOX*
Keying Ren[1], Xiaoyan Chen[1], Wangzi Chen[1], Xiaoning Yan[2], Dongyang Zhang[1]
([1]Tianjin University of Science and Technology, China)
([2]Shenzhen Softsz Co. Ltd., China)

OS11-4   *An improved small target detection method based on YOLOv4*
Xia Miao[1], Xiaoyan Chen[1], Keying Ren[1], Zichen Wang[1], Xiaoning Yan[2], Yue Sun[2]
([1]Tianjin University of Science and Technology, China)
([2]Shenzhen Softsz Co. Ltd., China)

OS11-5   *Yolov5-DP: A new method for detecting pedestrian aggregation*
Kunzhi Yang[1], Xiaoyan Chen[1] Xiaoning Yan[2], Dashuo Wu[2]
([1]Tianjin University of Science and Technology, China)
([2]Shenzhen Softsz Co. Ltd., China)

OS11-6   *Flame Recognition based on Yolov5 Algorithm*
Kunzhi Yang[1], Xiaoyan Chen[1] Xiaoning Yan[2], Dongyang Zhang[2]
([1]Tianjin University of Science and Technology, China)
([2]Shenzhen Softsz Co. Ltd., China)

OS11-7   *Research on face detection algorithm based on improved YOLOv5*
Zhen Mao[1], Xiaoyan Chen[1], Xiaoning Yan[2], Yuwei Zhao[2]
([1]Tianjin University of Science and Technology, China)
([2]Shenzhen Softsz Co. Ltd., China)

OS11-8   *Visibility analysis based on a novel A-VGGNet network*
Zhen Mao[1], Xiaoyan Chen[1], Xiaoning Yan[2], Shuangwu Zheng[2]
([1]Tianjin University of Science and Technology, China)
([2]Shenzhen Softsz Co. Ltd., China)

OS11-9   *Price Prediction of Diamonds*
Xiran Wen, Qiqi Xu, Zirui Su, Jiayi Fang
(The Chinese University of Hong Kong, China)

Meeting Room 2
9:00-10:15 OS6 Bio-inspired Artificial Vision -Systems and Applications- (5)
Chair: Shinsuke Yasukawa (Kyushu Institute of Technology, Japan)
Co-Chair: Yuki Hayashida (Mie University/Osaka University, Japan)

OS6-1   *The effect of preprocessing with Gabor filters on image classification using CNNs*
Akito Morita, Hirotsugu Okuno (Osaka Institute of Technology, Japan)

OS6-2   *An image coding algorithm with color constancy using the Retinex theory and the Naka-Rushton equation*
Shota Hisamitsu, Hirotsugu Okuno (Osaka Institute of Technology, Japan)

OS6-3   *A fast image sensor system with an efficient multi-scale Gaussian filtering circuit*
Yuuki Yamaji, Akito Morita, Hirotugu Okuno (Osaka Institute of Technology, Japan)

OS6-4   *A robotic vision system emulating fixational eye movements and retinal sampling*
Takanori Yotsumoto[1], Yuki Hayashida[2], Shinsuke Yasukawa[1]
([1]Kyushu Institute of Technology), ([2]Mie University, Japan)

OS6-5   *A bench-test system of the cortical prostheses utilizing retino-morphic spike as the driver signal of intracortical microstimulation*
Ryosuke Okada[1], Shinnosuke Ishikawa[2], Tetsufumi Tasaki[2], Tetsuya Yagi[2,3], Yuki Hayashida[1,2]
([1]Mie University, [2]Osaka University, [3]Fukui University of Technology, Japan)

10:45-12:00 GS2 Learning Methods (5)
Chair: Masato Nagayoshi (Niigata College of Nursing, Japan)

GS2-1   *A basic study of how to exchange work shifts using reinforcement learning on a constructive nurse scheduling system*
Masato Nagayoshi (Niigata College of Nursing, Japan)
Hisashi Tamaki (Kobe University, Japan)

GS2-2   *Developing Machine Learning and Deep Learning Models for Customer Churn Prediction in Telecomunication Industry*
Teoh Jay Shen, Abdul Samad Shibghatullah (UCSI University, Malaysia)

GS2-3   *Liver Segmentation in CT Images Using Deep-Learning and 3D CRF*
Shuntaro Nagano[1], Guangxu Li[2], Tohru Kamiya[1]
([1]Kyushu Institute of Technology, Japan), ([2]Tiangong University, Tianjin, China)

GS2-4   *Judgement on Shunt Sounds from Vascular Access using YOLO Deep Learning Model*
[1]Kyosuke Fujiwara, [1]Takayuki Yamamoto, [1]Lindsey Tate, [2]Kazuya Kibune, [1]Hiroki Tamura
([1]University of Miyazaki, Japan), ([2]Tokatsu Dialysis Hospital & Clinics, Japan)

GS2-5   *Research of Classification of Palmprint Based on Deep Learning*
Kunyu Yu, Hiroshi Matsuki (Ashikaga University, Japan)

14:20-16:15 OS19 Industrial Artificial Intelligence Robotics (7)
Chair: Eiji Hayashi (Kyushu Institute of Technology, Japan)
Co-Chair: Sakmongkon Chumkamon (Kyushu Institute of Technology, Japan)

OS19-1   *Online Deep Reinforcement Learning on Assigned Weight Spaghetti Grasping in One time using Soft Actor-Critic*
Prem Gamolped, Sakmongkon Chumkamon, Tomofumi Tsuji, Nattapat Kloomklang, Chanapol Piyavichayanon, Ranatchai Laosiripong, Eiji Hayashi (Kyushu Institute of Technology, Japan)

OS19-2   *The research about editing system of performance information for player piano. -Inference in the same phrase including ostinato-*
Haruna Yamasaki, Sakmongkon Chumkamon, Eiji Hayashi (Kyushu Institute of Technology, Japan)

OS19-3   *Weight estimation for noodle products in food layout of a home replacement meal*
Tomofumi Tsuji[1], Sakmongkon Chumkamon[1], Chanapol Piyavichayanon[1], Prem Gamolped[1], Ranatchai Laosiripong[1], Ayumu Tominaga[2], Ryusuke Fujisawa[1], Eiji Hayashi[1]
([1]Kyushu Institute of Technology, Japan)
([2] National Institute of Technology, Kitakyushu College, Japan)

OS19-4   *Cognition of surrounding conditions for a field robot Slope detection using a multilayer perceptron classifier with point cloud as input –*
Takumi Tomokawa[1], Sakmongkon Chumkamon[1], Ayumu Tominaga[2], Sylvain Geiser[1], Ryusuke Fujisawa[1], Eiji Hayashi[1]
([1]Kyushu Institute of Technology, Japan)
([2]National Institute of Technology, Kitakyushu College, Japan)

OS19-5   *Particle Filter Based SLAM For Forestry Robot*
Sylvain Geiser[1], Sakmongkon Chumkamon[1], Ayumu Tominaga[2], Takumi Tomokawa[1], Eiji Hayashi[1]
([1]Kyushu Institute of Technology, Japan)
([2] National Institute of Technology, Kitakyushu College, Japan)

OS19-6   *Anomaly Detection using Autoencoder with Gramian Angular Summation Field in Time Series Data*
Umaporn Yokkampon[1], Sakmongkon Chumkamon[1], Abbe Mowshowitz[2], Eiji Hayashi[1]
([1]Kyushu Institute of Technology, Japan), ([2]The City College of New York, USA)

OS19-7   *Autonomous Robot Packaging Ready Meal in Conveyor Production Line*
Sakmongkon Chumkamon, Tomofumi Tsuji, Prem Gamolped, Chanapol Piyavichayanon, Umaporn Yokkampon, Eiji Hayashi (Kyushu Institute of Technology)

16:40-17:25 OS18 Natural Computing (3)
Chair: Marion Oswald (Technische Universität Wien, Austria)
Co-Chair: Yasuhiro Suzuki (Nagoya University, Japan)

OS18-1   *An Acoustic Artificial Life System Using the Game of Life and its Application for Performing Arts*
Yasuhiro Suzuki (Nagoya University Japan)

OS18-2   *The Effect of Non-audible Low Frequency, Deep Micro Vibrotactile, DMV Sounds on Music*
Yasuhiro Suzuki (Nagoya University, Japan)

OS18-3   *Response of Yeast to Low Frequency Sound Exposure*
Yasuhiro Suzuki (Nagoya University, Japan)

Meeting Room 3
9:00-10:15 OS15 Artificial Intelligence for Embedded Systems and Robotics (5)
Chair: Hakaru Tamukoh (Kyushu Institute of Technology, Japan)
Co-Chair: Takuya Nanami (University of Tokyo, Japan)

OS15-1   *INT8 Activation Ternary or Binary Weights Networks*
            Ninnart Fuengfusin, Hakaru Tamukoh (Kyushu Institute of Technology, Japan)

OS15-2   *A parameter tuning method for PQN model*
            Daimon Sakai, Takuya Nanami, Takashi Kohno (University of Tokyo, Japan)

OS15-3   *Hardware Development of Edge-Preserving Bubble Image Conversion in High-level Synthesis*
            Jiang Qin, Akira Yamawaki (Kyushu Institute of Technology, Japan)

OS15-4   *Development of Haze Removing Hardware Using High-Level Synthesis*
            Daiki Shirai and Akira Yamawaki (Kyushu Institute of Technology, Japan)

OS15-5   *Automatic approximation of primitive shapes using point clouds*
            Yuma Yoshimoto, Hakaru Tamukoh (Kyushu Institute of Technology, Japan)

10:45-12:00 OS24 Artificial Systems and Life (5)
Chair: Kuo-Hsien Hsia (National Yunlin University of Science and Technology, Taiwan)
Co-Chair: Chung-Wen Hung (National Yunlin-University of Science and Technology, Taiwan)

OS24-1   *An EtherCAT Based Delta Robot Synchronous Control Application*
            Chung-Wen Hung[1], Yu-Hsuan Tseng[1], Chau-Chung Song[2], Guan-Yu Jiang[1]
            ([1]National Yunlin-University of Science and Technology, Taiwan, [2]National Formosa University, Taiwan)

OS24-2   *Web-based SCADA using MQTT Protocol and AES*
            Jr-Hung Guo, Tzu-Yuan Lin, Kuo-Hsien Hsia
            (National Yunlin-University of Science and Technology, Taiwan)

OS24-3   *Smart Identification System of Teaching-type Autonomous Vehicles*
            Chun-Chieh Wang (Chienkuo Technology University, Taiwan)

OS24-4   Automatic Anti-Lock Brake System for Anti-Rollover Control of Autonomous Heavy-Duty Truck
            Chian C. Ho, Riki Umami Sanaz Ulfitria
            (National Yunlin-University of Science and Technology, Taiwan)

OS24-5   *Development of Intelligent Beehive and Network Monitoring System for Bee Ecology*
            Chau-Chung Song[1], Geng-Yi Lin[1], Chi-Chung Peng[2] and Chung-Wen Hung[3]
            ([1, 2]National Formosa University, Taiwan, [3]National Yunlin-University of Science and Technology, Taiwan)

14:20-16:00 OS26 Intelligent Life and Data Analysis (6)
Chair: I-Hsien Liu (National Cheng Kung University, Taiwan)
Co-Chair: Chu-Fen Li (National Formosa University, Taiwan)

OS26-1   *Data Balanced Algorithm Based on Generative Adversarial Network*
I-Hsien Liu, Cheng-En Hsieh, Wei-Min Lin, Jung-Shian Li (National Cheng Kung University, Taiwan),
Chu-Fen Li (National Formosa University, Taiwan)

OS26-2   *Fault-Tolerant Control System Design for Nonlinear System with Actuator Faults*
Ho-Nien Shou (Air Force Institute of Technology, Taiwan)
Hsin-Yu Lai (National Cheng Kung University, Taiwan)

OS26-3   *Key Indicators for Successful E-Oriented Operation and Management of the Nutrition Consulting Service System*
Ling-Mei Hsu (Chang Jung Christian University, Taiwan)

OS26-4   *The key factors for the application of blockchain into ocean Freight Forwarders: An Industry Perspective*
Chu-Ting Hsu, Ming-Tao Chou, Ji-Feng Ding (Chang Jung Christian University, Taiwan)

OS26-5   *Key Success Factors for Implementation Quality Assurance of Information Technology in Tourism Industry*
Shuen-Huei Yao, (Chang Jung Christian University, Taiwan), Cheng Chung Yeh
(National University of Tainan, Taiwan), Wen Jung Tsai (Chang Jung Christian University, Taiwan)

OS26-6   *AI Big data analysis and application: Patient Safety Culture of Nursing Staff in an Operation Room*
Su-Chiu Hsiao (Chang Jung Christian University, Taiwan)

16:40-18:50 OS17 Advanced Robotics (8)
Chair: Evgeni Magid (Kazan Federal University, Russia)
Co-Chair: Kuo-Hsien Hsia (National Yunlin University of Science and Technology, Taiwan)

OS17-1   *Experience in efficient real office environment modelling in Gazebo: a tutorial*
Bulat Abbyasov[1], Kirill Kononov[1], Tatyana Tsoy[1], Martínez-García Edgar A.[2], Evgeni Magid[1]
([1]Kazan Federal University, Russia), ([2]The Autonomous University of Ciudad Juarez, Mexico)

OS17-2   *Graphical user interface design for a UAV teleoperation*
Roman Lavrenov[1], Ramil Safin[1], Bai Yang[2], Martínez-García Edgar A.[3], Roman Meshcheryakov[4]
([1]Kazan Federal University, Russia), ([2]Ritsumeikan University, Japan)
([3]The Autonomous University of Ciudad Juarez, Mexico)
([4]V. A. Trapeznikov Institute of Control Sciences of Russian Academy of Sciences, Russia)

OS17-3   *Numerical solution approach for the ROBOTIS OP2 humanoid hand inverse kinematics*
Zagidullin Linar[1], Tatyana Tsoy[1], Roman Meshcheryakov[2], Kuo-Hsien Hsia[3], Evgeni Magid[1]
([1]Kazan Federal University, Russia)
([2]V. A. Trapeznikov Institute of Control Sciences of Russian Academy of Sciences, Russia)
([3]National Yunlin University of Science and Technology, Taiwan)

OS17-4   *Alvus modelling in Gazebo*
           Liaisan Safarova[1], Bulat Abbyasov[1], Tatyana Tsoy[1], Hongbing Li[2], Evgeni Magid[1]
           ([1]Kazan Federal University, Russia), ([2]Shanghai Jiao Tong University, China)

OS17-5   *Testing procedures architecture for establishing a fiducial marker recognition quality in UAV-based visual marker tracking task in Gazebo simulator*
           Mikhail Kilin[1], Roman Lavrenov[1], Bai Yang[2], Mikhail Svinin[2], Evgeni Magid[1]
           ([1]Kazan Federal University, Russia), ([2]Ritsumeikan University, Japan)

OS17-6   *Feature importance evaluation method for multi-agent deep reinforcement learning in advanced robotics task allocation*
           Sergey Ryabtsev[1], Mikhail Gurchinsky[1], Igor Struchkov[1], Vyacheslav Petrenko[1], Fariza Tebueva[1], Sergey Makarenko[2]
           ([1]North-Caucasus Federal University, Russia),
           ([2]Saint Petersburg Federal Research Center of the Russian Academy of Sciences, Russia)

OS17-7   *Iterative method of labor division for multi-robotic systems*
           Sergey Ryabtsev[1], Artur Sakolchik[2], Vladimir Antonov[1], Vyacheslav Petrenko[1], Fariza Tebueva[1], Sergey Makarenko[3]
           ([1]North-Caucasus Federal University, Russia),
           ([2]Belarusian State University, Belarus)
           ([3]Saint Petersburg Federal Research Center of the Russian Academy of Sciences, Russia)

OS17-8   *Development of Bowling Machine Using VEX IQ*
           Kuo-Hsien Hsia[1], Ya-Chun Chen[1], Evgeni Magid[2], Xin-Ying Zeng[1]
           ([1]National Yunlin University of Science and Technology, Taiwan)
           ([2]Federal Kazan University, Russia)

Meeting Room 4
9:00-10:30 GS1 Control System Applications (6)
Chair: Hiroaki Wagatsuma (Kyushu Institute of Technology, Japan)

GS1-1   *Design of local linear models using Self tuning Control System for PID Tuning According to error*
           Shinichi Imai (Tokyo gakugei university, Japan)

GS1-2   *A Systematic Analysis of the Knee Support Exoskeleton Based on Multibody Dynamics Toward Personalization with 3D Printed Spring-Damper Components*
           Shintaro Kasai[1], Pancho Dachikinov[1], Kohei Tanaka[1], Hiroaki Wagatsuma[1,2]
           ([1]Kyushu Institute of Technology, Japan; [2]RIKEN CBS, Japan)

GS1-3   *A Drone-Based Concrete Crack Inspection System by Using Morphological Component Analysis and Sub-Pixel Width Estimation*
           Ankur Dixit[1], Wataru Oshiumi[1], Hiroaki Wagatsuma[1,2]
           ([1]Kyushu Institute of Technology, Japan; [2]RIKEN CBS, Japan)

GS1-4 *A Systematic Geometric Design Method of Flexible Bars Available for Personalized Knee Orthoses with Spring-Damper Functions*
Pancho Dachikinov[1], Shintaro Kasai[1], Kohei Tanaka[1], Hiroaki Wagatsuma[1,2]
([1]Kyushu Institute of Technology, Japan; [2]RIKEN CBS, Japan)

GS1-5 *State-space modeling of fingers motion measured by the Leap Motion Controller*
Ryuichi Usami, Hideyuki Tanaka (Hiroshima University, Japan)

GS1-6 *Applicability Verification of iWakka Game to Children with Developmental Coordination Disorder*
Masakazu Nomura[1], Moe Nishiya[1], Yoshifumi Morita[1], Hideo Yamagiwa[2]
([1]Nagoya Institute of Technology, Japan) ([2]Tokyo Metropolitan Tobu Medical Center, Japan)

10:45-12:00 OS27 Environmental Monitoring (5)
Chair: Kazuo Ishii (Kyushu Institute of Technology)
Co-Chair: Keisuke Watanabe (Tokai University)

OS27-1 *Biofouling Monitoring Experiments of Underwater Concrete Samples for Offshore Platform Cleaning Robot Development*
Keisuke Watanabe[1], Hiroki Goda[2], Koji Harada[3]
([1]Tokai University, Japan, [2]Kyusyu Institute of Technology, Japan, [3]Nishimatsu Construction Co., Ltd., Japan)

OS27-2 *Fall risk notification system using LiDAR sensor for the visually impaired people*
Daigo Katayama[1], Kazuo Ishii[1], Shinsuke Yasukawa[1], Satoshi Nakadomari[2], Koichi Wada[2], Akane Befu[2], Chikako Yamada[2] ([1]Kyushu Institute of Technology, Japan, [2]NEXT VISION, Japan)

OS27-3 *Reflection Coefficient Estimation through the Modelling of Ultrasonic Transmission*
Ryuugo Mochizuki, Yuya Nishida, Kazuo Ishii (Kyushu Institute of Technology, Japan)

OS27-4 *Evaluation of Maps Constructed by Crawler-type Agricultural Robot in Different Farms*
Takuya Fujinaga, Tsuneo Nakanishi (Fukuoka University, Japan)

OS27-5 *An Estimation Method of Coastal Ocean Debris Using Aerial Drone*
Kazuo Ishii[1], Kanako Shirahashi[1], Yuya Nishida[1], Moeko Tominaga[2], Yoshiki Tanaka[1], Dominic B. Solpico[1] ([1]Kyushu Institute of Technology, Japan, [2]Nishinippon Institute of Technology, Japan)

14:20-16:30 OS29 Advances in Marine Robotics and Their Applications (8)
Chair: Keisuke Watanabe (Tokai University)
Co-Chair Kazuo Ishii (Kyushu Institute of Technology)

OS29-1 *A Sensor Network to Estimate Fish Activity and Assist Feeding Decisions in Marine Aquaculture*
Dominic B. Solpico, Yuya Nishida, Kazuo Ishii (Kyushu Institute of Technology, Japan)

OS29-2   *Proposal of a Swarm Intelligent Underwater Glider System for a Long-term Three-dimensional Wide-area Ocean Observation*
Kanako Kobatake, Masakazu Arima (Osaka Prefecture University, Japan)

OS29-3   *Underwater Acoustic Communication using QPSK Modulation Method*
Yuya Nishida, Yuichiro Uemura, Rikuto Tanaka, Kazuo Ishii (Kyushu Institute of Technology, Japan)

OS29-4   *Ultrasonic Cleaner using Two Transducers for Ship Hull Cleaning Robot*
Yuya Nishida, Toshihiro Matsumura, Kazuo Ishii (Kyushu Institute of Technology, Japan)

OS29-5   *Motion Control of a Ship Hull Cleaning Robot*
Hyoga Yamamoto, Yuya Nishida, Takayuki Matsuo, Kazuo Ishii (Kyushu Institute of Technology, Japan)

OS29-6   *Development of a USV Testbed and Its System Check Experiments at Sea*
Keisuke Watanabe, Masatoshi Shimpo (Tokai University, Japan)

OS29-7   *Development of a Seabed Walking Platform for Ore Sample Drilling in Deep Sea Mining*
Keisuke Watanabe[1], Hideyuki Suzuki[2], Yoshiyasu Watanabe[1]
([1]Tokai University, Japan), ([2]The University of Tokyo, Japan)

OS29-8   *Development of Remotely Operated Vehicle for Small-size Jellyfish Extermination and its Evaluation of Extermination Motion Control*
Hiroyuki Yokota[1], Shinsuke Yasukawa[2], Jonghyun Ahn[1]
([1]Hiroshima Institute of Technology, Japan, [2]Kyushu Institute of Technology, Japan)

January 23 (Sunday)
8:40-Registration

Meeting Room 1
9:00-10:30 OS3 Intelligent Systems and Robotics -1- & OS8 Intelligent Systems and Robotics -3-

OS3 Intelligent Systems and Robotics -1- (6)
Chair: Peng Lu (Tianjin University of Science and Technology, China)
Co-Chair: Fengzhi Dai (Tianjin University of Science and Technology, China)

OS3-1   *A Distributed Optimal Formation Control for Multi-Agent System Based on UAVs*
Jichao Zhao[1], Fengzhi Dai[1], Yunzhong Song[2]
([1]Tianjin University of Science and Technology, China), ([2]Henan Polytechnic University, China)

OS3-2   *A Design of Multi-Agent System Simulation Platform Based on Unmanned Ground Vehicles and A Research on Formation Control Protocol*
Chuang Zhang, Jichao Zhao, Fengzhi Dai (Tianjin University of Science and Technology, China)

OS3-3   *A Study of Weighted Average Method for Multi-sensor Data Fusion*
Peng Lu[1], Fengzhi Dai[1,2]
([1] Tianjin University of Science and Technology, China),
([2] Tianjin Tianke Intelligent and Manufacture Technology CO., LTD, China)

OS3-4   *A Design of Wide-angle Open and Close Multifunctional Smart Windows*
Zilong Liu, Fengzhi Dai*, Luqi Shen, Jiarun Xu, Longyu Gao
(Tianjin University of Science and Technology, China)

OS3-5   *A Low-intensity Laser Control System Design*
Yuhui Cheng, Fengzhi Dai (Tianjin University of Science and Technology, China)

OS3-6   *A Review of Machine Vision Based Fruit Recognition Applications*
Tianyi Zhang, Fengzhi Dai (Tianjin University of Science and Technology, China)

OS8 Intelligent Systems and Robotics -3- (4)
Chair: Tianyi Zhang (Tianjin University of Science and Technology, China)
Co-Chair: Yiting Gao (Tianjin University of Science and Technology, China)

OS8-1   *A Portable Electrocardiograph System Design based on STM32 Chip*
Tianyi Zhang, Huating Liu (Tianjin University of Science and Technology, China)

OS8-2   *Design and Development of The Parking Space Autonomous Management System*
Yiting Gao, Tianyi Zhang (Tianjin University of Science and Technology, China)

OS8-3   *An Overview of Obstacle Avoidance Methods for Unmanned Vehicles*
Peng Lu, Haokang Wen (Tianjin University of Science and Technology, China)

OS8-4   *Synchronization of Novel 5D Hyperchaotic Systems*
Hong Niu (Tianjin University of Science & Technology, China)

Meeting Room 2
10:50-11:50 OS7 Media Information Processing, Music Recommendation and Artificial Intelligence (4)
Chair: Yasunari Yoshitomi (Kyoto Prefectural University, Japan)
Co-Chair: Masayoshi Tabuse (Kyoto Prefectural University, Japan)

OS7-1   *Data expansion method by combining unnecessary sentence deletion and most important sentence addition*
Tomohito Ouchi, Masayoshi Tabuse (Kyoto Prefectural University, Japan)

OS7-2   *Evaluation of a system that the reading of sentences by a voice synthesizer and the highlighting sentences*
Sota Kobayashi, Masayoshi Tabuse (Kyoto Prefectural University, Japan)

OS7-3   *Mouse Cursor Control System using Eye Gaze and detection of eye opening and closing*
Masayoshi Tabuse, Mana Fukumoto, Yasunari Yoshitomi, Taro Asada
(Kyoto Prefectural University, Japan)

OS7-4   *Music Recommendation System Driven by Facial Expression Recognition*
Taro Asada[1], Motoki Kawamura[2], Yasunari Yoshitomi[1], Masayoshi Tabuse[1]
([1]Kyoto Prefectural University, Japan, [2]Fujitsu Limited, Japan)

13:00-14:40 OS20 Application studies on sensor and RFID system (6)
Chair: Ammar A.M. Al-Talib (UCSI university, Malaysia)
Co-Chair: Takao Ito (Hiroshima University, Japan)

OS20-1   *A Pedal Powered Water Purifier*
Ammar A.M. Al-Talib, Ting Kee Yuan, Sarah 'Atifah Saruchi (UCSI University, Malaysia)

OS20-2   *A Smart Node (Maintenance & Lifespan Prediction System)*
Kam Heng Chaw[1], Ammar A.M. Al-Talib[2], Tarek Fawzi[2], Jonathan Yong Chung Ee[2]
([1]MODU System (S) Pte Ltd, Malaysia), ([2]UCSI University, Malaysia)

OS20-3   *A Healthcare Laundry Management System using RFID System*
Eryana Hussin, Wong Jie Jian (UCSI University, Malaysia)

OS20-4   *A Monitoring System with Humidity and Growth Level Detection for Horticulture*
Eryana Hussin, Ng Joon Wen (UCSI University, Malaysia)

OS20-5   *A Double Identification Attendance System Using High Frequency RFID System*
Eryana Hussin, Wong Chee Ming (UCSI University, Malaysia)

OS20-6   *Levitating Frictionless-Vertical Windmill-*
Ammar A.M. Al-Talib, Muhammad R. Md. Redzuan (UCSI University, Malaysia)

Meeting Room 3
9:00-11:50 OS9 Robot Control (10)
Chair: Yizhun Peng (Tianjin University of Science and Technology, China)
Co-Chair: Junhui Yin (Tianjin University of Science and Technology, China)

OS9-1   *Design of Analog Electromagnetic Gun Based on Arduino*
Lintao Hu, Yizhun Peng (Tianjin University of Science and Technology, China)

OS9-2   *A Design of Intelligent House Inspection Robot*
Sicong Wang, Yizhun Peng (Tianjin University of Science and Technology, China)

OS9-3   *A Design of Embedded Plate & Ball Control System Based on Machine Vision*
Wendinig Luo[1], FuChen Zhao[2]
([1]Beijing Huadian Jingneng Energy Technology Co., China)
([2]Beijing University of Posts and Telecommunications, China）

OS9-4   *Design of Blood Circulation System of Medical Simulation Robot*
Songyun Shi, Yang Ge, Chomgxu Guo, Yizhun Peng
(Tianjin University of Science and Technology, China)

OS9-5   *A Design of Dynamic Exoskeleton for Self-learning Human Movements*
Qingliang Liu, Yucheng, Pengyu Yao, Dechao Wang, Yizhun Peng
(Tianjin University of Science and Technology, China)

OS9-6   *Design of Autonomous navigation building Climbing and Handling Robot Based on SLAM*
Linhui Chen, Junjie Tai, Yizhun Peng (Tianjin University of Science and Technology, China)

OS9-7   *Simulation Research on Automatic Navigation of Indoor Wheelchair*
Peng Shi, Yizhun Peng (Tianjin University of Science and Technology, China)

OS9-8   *Design of a Humanoid Dance Robot for Dancing Baduanjin*
Zhuofan Xu, Ruitao Li, Binfu Zhong, Yizhun Peng
(Tianjin University of Science and Technology, China)

OS9-9   *Design of Intelligent Shading System Suitable for Parenting Products*
Yihan Yan, Songyun Shi, Yaxin Shen, Yizhun Peng
(Tianjin University of Science and Technology, China)

OS9-10   *Design of Intelligent Personalized Nutrition Supplement Machine*
Xinpeng Yang, Sidan Liu, Rui Li, Junhui Yin, Yizhun Peng
(Tianjin University of Science and Technology, China)

13:00-15:25 OS32 Human-Machine Interface and Automation (9)
Chair: Norrima Mokhtar (University of Malaya, Malaysia)
Co-Chair: Fakhrul Hazman Yusoff (UITM, Malaysia)

OS32-1   *A Derivative Oriented Thresholding Approach for Feature Extraction of Mold Defects on Fine Arts Painting*
Hilman Nordin, Bushroa Abdul Razak, Norrima Mokhtar, Mohd Fadzil Jamaludin
(Universiti Malaya, Malaysia)

OS32-2   *Imaginary Finger Control Detection Algorithm Using Deep Learning with Brain Computer Interface (BCI)*
Suresh Gobee[1], Norrima Mokhtar[1], Hamzah Arof[1], Noraisyah Md Shah[1], Wan Khairunizam[2]
([1]Universiti Malaya, Malaysia), ([2]University Malaysia Perlis, Malaysia)

OS32-3   *Investigating the Effect of Individuality Factors in Measuring Aggresion Induced by Human Brain*
Wan Khairunizam[1], Kai Xu tung[1], Lugieswaran[1], Wan Azani Mustafa[1], Hashimah Ali[1],
Zuradzman M. Razlan[2], Shahriman AB[2], Norrima Mokhtar[3]

([1]University Malaysia Perlis, Malaysia), ([2]Universiti Malaya, Malaysia)

OS32-4   *Voice User Interface(VuI) Smart Office Door Application in the Context of Covid-19 Pandemic*
Muhammad Zharif Aiman Alias, Wan Norsyafizan W. Muhamad, Suzi Seroja Sarnin, Darmawaty Mohd Ali (University Technology MARA, Malaysia)

OS32-5   *Endometrial Cell Images Segmentation: A Comparative Study*
Wan AzaniMustafa[1], Nurul Umaira Salim[1], Wan Khairunizam[1], Shahrina Ismail[1], Hiam Alquran[2]
([1]Universiti Malaysia Perlis, Malaysia; [2]Yarmouk University, Jordan)

OS32-6   *Temperature Control Using Fuzzy Controller for Variable Speed Vapor Compression Refrigerator System*
Siti Qurrata Ain Suhaimi, M. Saifizi, S.M. Othman, Azri A. Aziz, Wan Azani Mustafa,
Wan Khairunizam (Universiti Malaysia Perlis, Malaysia)

OS32-7   *Automatic Dry Waste Classification for Recycling Purpose*
Muhammad Nuzul Naim Baharuddin[1], Hasan Mehmood Khan[1], Norrima Mokhtar[1], Heshalini Rajagopal[2], Tarmizi Adam[3], Wan Amirul Wan Mahiyiddin[1],
Jafferi Jamaluddin[4]
([1]Universiti Malaya, Malaysia). ([2]Manipal International University, Malaysia),
([3]Universiti Teknologi Malaysia, Malaysia), ([4]UMPEDAC Universiti Malaya, Malaysia)

OS32-8   *A Low Cost Smart Parcel Box System with Enhanced Security*
Ahmad Luqmanulhakim, Wan Norsyafizan W. Muhamad, Suzi Seroja Sarnin, Meor Mohd Azreen Meor Hamzah (Universiti Teknologi MARA, Malaysia)

OS32-9   *Classification of Body Mass Index Based Face Images Using Facial Landmarks Approach and PCA plus LDA*
Hasimah Ali[1], Ho Yong Kang[1], Wan Khairunizam Wan Ahmad[1], Mohamed Elshaikh[1],
Norrima Mokhtar[2]
([1]University Malaysia Perlis, Malaysia), ([2] University of Malaya, Malaysia)

Meeting Room 4
9:00-11:35 OS31 Approaches to Post-Narratology that Combines AI and Cognitive Science with Narratology (9)
Chair: Jumpei Ono (Aomori University, Japan)
Co-Chair: Hiroki Fxyma (Tainan University of Technology, Taiwan)
Co-Chair: Takashi Ogata (Iwate Prefectural University, Japan)

OS31-1   *Story Units of the Types of Japanese Folktales and the Combination with a Noun Conceptual Dictionary*
[1]Jumpei Ono, [2]Motoki Kumagai, [2]Takashi Ogata
([1]Aomori University, Japan), ([2]Iwate Prefectural University, Japan)

OS31-2   *Visualization of the Unconscious in Quality Inspection in Manufacturing*
Jun Nakamura (Chuo University, Japan)

OS31-3   *The Study on the Relationship Between the Comic Artists' Styles and the Visual Languages: From the Stylistic Changes in the Work of Japanese Comic Artists*
Kaori Otsuru (Tainan University of Technology, Taiwan (ROC))

OS31-4   *Theoretical Backgrounds toward Text Mining for a Phenomenological Model of Taste Perception*
Hiroki Fxyma (Tainan University of Technology, Taiwan)

OS31-5   *Why is the Early Detection of Dementia Failed?*
Yuki Hayashi (Chiba University/National Institute for Japanese Language and Linguistics, Japan)

OS31-6   *Relationship Between World-view and Advertising Techniques*
Yoji Kawamura (Kindai University, Japan)

OS31-7   *Adjective and Adjective Verb Conceptual Dictionaries in an Integrated Narrative Generation System*
Jumpei Ono (Aomori University, Japan), Takashi Ogata (Iwate Prefectural University, Japan)

OS31-8   *Prototyping Animation System that Combines a Kabuki Work and its Background Story:* Kyōganoko Musume Dōjōji *and the Legend of* Dōjōji
[1]Miku Kawai, [2]Shunta Kudo, [3]Jumpei Ono, [2]Takashi Ogata
([1]The Open University of Japan, Japan), ([2]Iwate Prefectural University, Japan)
([3]Aomori University, Japan)

OS31-9   *How Will Art Appreciations Change According to Information Change?*
Akinori Abe (Chiba University, Japan)

13:00-15:10 OS12 Intelligent Measurements and Control Systems (8)

Chair: Xiaoyan Chen (Tianjin University of Science and Technology, China)

Co-Chair: Shiming Wang (Tianjin University of Science and Technology, China)

OS12-1   *Research on an AGV path planning method*
Zhihui Chen, Xiaoyan Chen, Shiming Wang (Tianjin University of Science and Technology, China)

OS12-2   *Boiler level measurement and control system*
Xiwen Liang, Shengli Sun, Xiaoyan Chen (Tianjin University of Science and Technology, China)

OS12-3   *Recurrence quantification and time-frequency analysis of two-phase flow patterns*
          Keying Ren, Xiaoyan Chen , Meng Du (Tianjin University of Science and Technology, China)

OS12-4   *Application of deep learning in automatic driving*
          Wei Su, Xiaoyan Chen (Tianjin University of Science and Technology, China)

OS12-5   *An intelligent home security system based on STM32*
          Wei Su[1], Xiaoyan Chen[1], Guangyong Xi[2]
          ([1]Tianjin University of Science and Technology, China)
          ([2]Zhengzhou University of Light Industry, China)

OS12-6   *Design of smart bracelet based on STM32 microcontroller*
          Xia Miao, Xiaoyan Chen, Jianliang Li (Tianjin University of Science and Technology, China)

OS12-7   *Design of material conveying and automatic sorting control system based on PLC*
          Qian Wang[1], XiaoYan Chen[1], Shengmin Cao[2]
          ([1]Tianjin University of Science and Technology, China), ([2]TangShan College, China)

OS12-8   *Image reconstruction based on ResV-Net for electrical impedance tomography*
          Qian Wang, ZiChen Wang, Di Wang, XiaoYan Chen
          (Tianjin University of Science and Technology, China)

Group Meeting for the next Conference

N-1   *Compact Ultra-Wideband Slotted Microstrip Patch Antenna for 5G, IoT and RFID Applications*
Gurney Nga, Mastaneh Moakyef, Shahid Manzoor, Manickam Ramasamy (UCSI University, Malaysia)

N-2   *Drone Performance Analysis Based on SNR Factor*
Gershom Phiri, Mastaneh Moakyef, Sew Sun Tiang, Wong Chin Hong (UCSI University, Malaysia)

Abstracts
PS abstracts (3)
PS1 Robotics for Growing Life

Henrik Hautop Lund (Technical University of Denmark, Denmark)

We present a novel direction of artificial life robotics in which we use robotics to control the growth of real, natural life. The concept of using robotics to grow life present itself as a potential sustainable solution for food production, allowing an optimization of food quality and outcome. We illustrate this concept with our development of the Growbot, which is a tabletop size robotic green house for growing edible food plant. The GrowBots use sensors such as humidity, CO_2, temperature, water level and camera sensors, and actuators such as full spectrum LEDs, IR LEDs, UV LEDs, fertilizer and water pumps, air change and air fan. The software acts as recipes for the plant growth in the robotic greenhouse adjusting the environmental condition for the growth of the living plants such as salad, parsley and basil.

PS2 Road To Cyber Physical Factory(Application Examples of Intelligent Factory and its Technology)

Hidehiko Yamamoto (Gifu University, Japan)

Since 1980, Computerized machine tools and robots have been developed. I talk about the history of the Intelligent manufacturing systems and their technology including Artificial Intelligence and GA. The technology are as follows. The future factory by using Autonomous System, we call Autonomous Decentralized Flexible Manufacturing Systems, is presented. The virtual factory and several kinds of simulations for production systems and scheduling problems is presented. The simulations application examples for automobile production lines are presented. IoT production and Cyber Physical Factory which is the near future manufacturing model are presented. Its application example for automobile parts production is also presented.
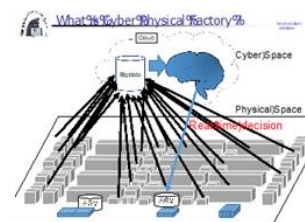
PS3 Robot Technology, and it's Development Trend–Developing a New Networking Robot System-

Takao Ito (Hiroshima University, Japan)

Robot technology has been changed dramatically with massive development of internet environment. The author reviewed a plethora of literature and investigated advanced robot technologies. Today, most of typical robot technologies are used in single-cause-oriented products, such as robot vacuum cleaner and Asimo, a humanoidrobot invented by Honda. These advanced products played important role in our modern society. For further development, a networking robot system with advanced technologies of internet and artificial intelligence is required in order to copy with theuncertainty in the future. Different technology should be combined and linked together for multiple-goal-oriented approach in the networking robot system. For evaluating the validity of our new system, a centrality index is introduced in this research.
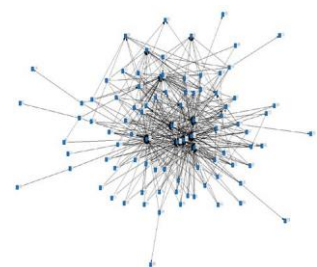
IS abstracts (3)
IS1-1 A physical to virtual control system implementing an art-based game.

Luigi Pagliarini[1,2], Henrik Hautop Lund[1]
([1]Technical University of Denmark, Denmark) ([2] Academy of Fine Arts of Macerata, Italy)

We hereby present Tiler, an art-based game where a virtual world made of tiles and controlled through a set of electronic cubes where players can/should gather the decoration of a floor based on aesthetical criteria. Such a tool allows projecting and designing bi-dimensional shapes by physically manipulating tri-dimensional objects. Besides that, Tiler, is an application that brings to life a clear example on how we can achieve new ways of interfacing the physical world with virtual ones. In the following article we introduce the logical and technical aspects of this real-to-virtual interface and show its potential applications in different fields
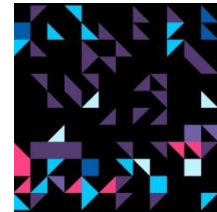
IS1-2 Creative Multisensory Environments

Henrik Hautop Lund[1], Luigi Pagliarini[1,2]
([1]Technical University of Denmark, Denmark), (Academy of Fine Arts of Macerata, Italy)

We outline the concept of playful creative multisensory environments. Multisensory environments are characterized by facilitating multimodal interaction by users through a composition of different objects. These objects allow manipulation of the environment. Multisensory rooms are often used to enhance users' sensations and emotions. In order to explore the development of such multisensory environments, which are playful and provide possibilities to become creative, we suggest the use of modular playware as part of the Playware ABC concept. This allows for the development of flexible, portable environments to be used by anybody, anywhere, anytime, and facilitates that the users can construct, combine and create. In this way, the users can become creative in seamless interaction with aesthetically pleasing environments. The paper outlines the lessons learned from the development and testing of a number of such playful creative multisensory rooms. Main findings are that such multisensory environments need to provide explicit immediate feedback, be simple in design, build on high quality aesthetics, provide variation, and be playful to result in intrinsic motivation.
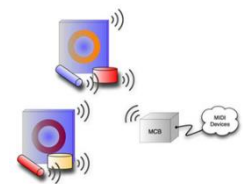
IS2-1 Using GrowBots to Study Heat and Nutrient Stress in Basil

Rishav Bose, Henrik Hautop Lund (Technical University of Denmark, Denmark)

We present how a novel type of robot called a food computer can be used to simulate abiotic stresses and study their impact on hydroponically grown Italian basil, Ocimum basilicum. The food computer called the GrowBot is a tabletop sized robotic greenhouse for growing edible food plants. The GrowBot's actuators were used to alter the environmental conditions in the growth chamber to study different aspects of plant growth and food production in varying climate scenarios. The experiments show how we can used the LED lights to control the temperature to a certain, desired range (29ºC – 35ºC) for the heat stress experiments, while measurements show that we can simultaneously obtain the photosythetically active radition (PAR) values to be in the ideal range for growth of the basil plants.

IS2-2 Convolutional Neural Network for Studying Plant Nutrient Deficiencies

Rishav Bose, Henrik Hautop Lund (Technical University of Denmark, Denmark)

We discuss the development of a vision-based plant phenotyping system based on a novel type of robotic system called a food computer. The food computer used in this project is called the GrowBot. It has a host of sensors to help analyse the growth chamber including a Raspberry Pi camera. The project revolved around developing a system to segment the plant canopy from its background and analyse nutrient deficiencies from the images taken by the camera. The pilot project investigated how a segmentation model called U-Net could be used to study the images. One of the drawbacks of many existing vision-based plant phenotyping systems is that their convolutional neural networks (CNNs) were trained to analyse very ideal images of individual leaves. This pilot project tried to address that issue, while at the same time explored how to train the neural networks to learn segmentation from a small image dataset.
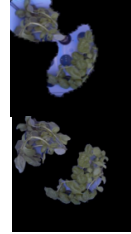
OS abstracts
OS1 Advanced Information Processing Applications (4)
Chair Toru Hiraoka (University of Nagasaki, Japan)
Co-Chair Masaharu Hirota (Okayama University of Science, Japan)

OS1-1 Generation of Checkered Pattern Images Using Prewitt Filter from RGB-D Images
Toru Hiraoka, Ryosuke Takaki (University of Nagasaki, Japan)

A non-photorealistic rendering method for generating checkered pattern images from gray-scale photographic images using Prewitt filter with an expanded window size has been proposed. In this paper, we propose an extension of the conventional method to apply to RGB-D images. Our method can change the size of the checkered patterns depending on the depth. To verify the effectiveness of our method, we conducted experiments that are visually confirmed the checkered patterns by changing the parameters in our method.

OS1-2 An Approach of Analyzing Movement Patterns Using Word Embeddings from Geo-tagged Tweets
Masahru Hirota, Tetsuya Oda (Okayama University of Science, Japan)

Many tourists upload geo-tagged content about tourist attractions to social media sites. The trajectories composed of those contents contribute to many applications, such as analyzing tourist behavior patterns, traffic flow analysis, and next location prediction.   In this paper, we analyze the movement patterns of users by clustering their movement trajectories in Twitter data. We use the word embedding model to learn movements between two places. Also, we cluster the trajectories based on the similarity calculated by the generated embedding vectors. We visualized the clustered trajectories on a map and discussed the result.

OS1-3 A Proposal of a Software Defect Predication System Using SOM
Yoshihiro Kita, Kazuki Ueda, Kiyotaka Sakurai (University of Nagasaki, Nihon Knowledge Co. Ltd, Japan)

The goal of software testing is to detect all potential defects. However, it is difficult to know how many latent defects remain and where they are hidden. In this research, we propose a system that analyzes the characteristics and tendencies of already detected defects and predicts where the potential defects are likely to be. Specifically, the system inputs the data of detected defects into a Self-Organization Map (SOM) and predicts the locations that contain many defects from this map. In order to confirm the validity of this proposal, we input past defect data into the SOM, analyze the trend of defects, and evaluate the predictability of the potential defects.
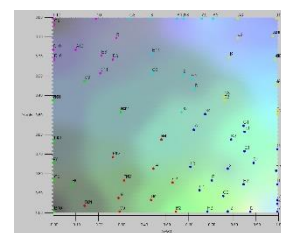
OS1-4 Mapping the Motion of Highly-inclined Triple System into a Secular Perturbation Model

Masaya M. Saito (University of Nagasaki, Japan)
Kiyotaka Tanikawa (National Astronomical Observatory, Japan)

The motions of three bodies like Sun-Asteroid-Jupiter system or triple star system are formalized as hierarchical three body problem. When the third body orbits around the rest in a highly inclined elliptic orbit, the system undergoes the oscillation, called the Kozai oscillation, where the eccentricity may increase with decrease of the inclination of the orbital plane. While the Kozai oscillation seems to be a key process in orbital evolution, including disruption of triple system, its reflection into actual trajectories is quite complicated to analyze. For this reason, we try to map these trajectories into a secular perturbation model with data assimilation and demonstrate the extraction of state and its transition (libration to circulation and vice versa) as the Kozai oscillation.
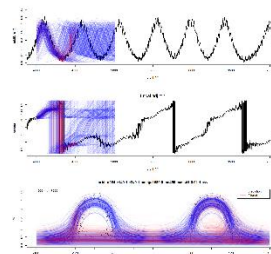
OS2 Advanced studies of interdisciplinary approach (4)

Chair Yousin Park (Prefectural University of Hiroshima, Japan))
Co-Chair Takao Ito (Hiroshima University, Japan)

OS2-1 Measuring the entire degree centrality in Yokokai

Tsutomu Ito[1], Matsuno Seigo[1], Sakamoto Makoto[2], Takao Ito[3]
([1]Ube National College of Technology, Japan), ([2]Univeristy of Miyazaki, Japan),
([3]Hiroshima University, Japan)

Centrality is one of the most important indexes in network calculation. Based on the definition, more than 400 different centrality such as degree, betweenness have been developed. All centrality indexes are calculated using the number of connection line, and its position in a given network. In automotive industry, keiretsu is considered as one of typical networks. It is critical to measure the centrality of transaction network in the keiretsu. It is widely well-known that different parts play different roles in a car. Thus, the importance of each connect line in a transaction network should be measured based upon the importance of the parts. A new parts-importance weighted centrality model is proposed in this paper.
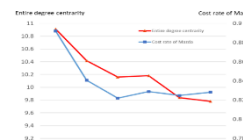
OS2-2 A comparative study on Michinoeki's efficiency in Japan

Tsutomu Ito[1], Matsuno Seigo[1], Sakamoto Makoto[2], Takao Ito[3]
([1]Ube National College of Technology, Japan), ([2]Univeristy of Miyazaki, Japan),
([3]Hiroshima University, Japan)

Michinoeki is considered as one of the most successful social experiments in Japan now. A plethora of literature of current situation analysis of Michinoeki's have been published over past decades. The authors reviewed many important and typical literatures and found that the quantitative studies are still sparse. Obviously, it is a critical issue to measure the efficiency of Michinoeki's for its further development and revitalization of the local economy. Thus, the data of Michinoeki are gathered from all Michinoeki in Japan, and the relative efficiency are calculated using DEA model for comparison. Furthermore, the managerial implication of the results is discussed in this paper.
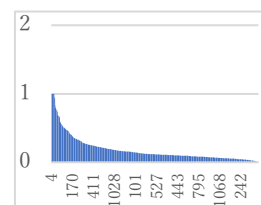
OS2-3 The R&D Direction and Business Strategy: The case study on the cooperation of EV and battery makers

Yousin Park[1], Iori Nakaoka[2], Yun-ju Chen[3]
([1]Prefectural University of Hiroshima, Japan), ([2]Seijoh University, Japan), ([3]Shiga University, Japan)

This paper focuses on the R&D direction and the business strategy of EV (Electric Vehicle) and battery makers. M. E. Porter (1996) claimed that the productivity frontier represents the maximum value that the organization can deliver at any a given cost, using technologies, skills and purchased inputs. He argued that strategic decisions are ones that are aimed at differentiating an organization from its competitors in a way that is sustainable in the future. We use the patent information of EV companies (Toyota, Tesla, VW) and battery makers (Panasonic, CATL, LG Chem) as the cases. And we examine our propositions by social network analysis and text mining. The analysis in this paper include: 1) To try to distinguish between differentiation and low-cost strategy, and visualize each firm's R&D direction, 2) To make discussion on business strategy and the R&D direction of EV companies and battery makers. In this paper we suppose that patterns of cooperation EV and battery makers.
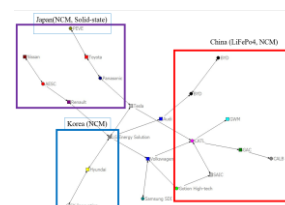
OS2-4 Discovering the relationship between tourists and tourist spots in Japan

Tsutomu Ito[1], Matsuno Seigo[1], Sakamoto Makoto[2], Takao Ito[3]
([1]Ube National College of Technology, Japan), ([2]Univeristy of Miyazaki, Japan),
([3]Hiroshima University, Japan)

It is widely well-known that Japan currently has serious problems with the declining birthrate and aging society. As actions to counteract our aging and shrinking population, revitalization of local economy is becoming the most effective economic development strategy. Obviously, tourism is considered as one of the effective policies to develop local economy today. To provide more practical evidence of tourism development, this paper is focusing on discovering the relationship between tourists and tourist spots using conventional regression model and 4-cell model developed on tourists and tourist spots. Moreover, as one of the successful factors, the importance of the development of public traffic among different tourist spots has been confirmed.
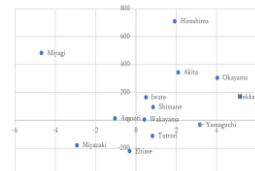
OS3 Intelligent Systems and Robotics-1 (6)
Chair Peng Lu (Tianjin University of Science and Technology, China)
Co-Chair Fengzhi Dai (Tianjin University of Science and Technology, China)

OS3-1 A Distributed Optimal Formation Control for Multi-Agent System Based on UAVs

Jichao Zhao[1], Fengzhi Dai[1], Yunzhong Song[2]
([1]Tianjin University of Science and Technology, China), ([2]Henan Polytechnic University, China)

In this paper, the distributed optimization problem of multi-agent system (MAS) formation control composed of unmanned aerial vehicles (UAVs) is solved. Aiming at the situation that the internal state of a single UAV can be fully understood, the internal optimal control law of a UAV is designed by using the optimal control theory. To solve the problem that each agent in the system can only communicate with some agents, the distributed formation control law of the system is designed based on the communication topology of the system, and the stability of the system is analyzed by the knowledge of graph theory. The validity of the formation protocol is verified by numerical simulation and UAV platform.
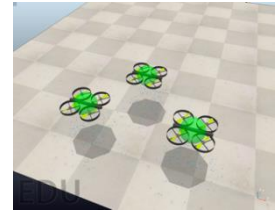
OS3-2 A Design of Multi-Agent System Simulation Platform Based on Unmanned Ground Vehicles and A Research on Formation Control Protocol

Chuang Zhang, Jichao Zhao, Fengzhi Dai (Tianjin University of Science and Technology, China)

Inspired by ants and fishes in nature, the multi-agent system (MAS) plays a huge role in production and manufacturing in modern society. This paper takes unmanned ground vehicles (UGVs) as the object and designs a multi-vehicle test platform, which is composed of UGVs, ultra-wideband (UWB), and Bluetooth Mesh. At the same time, the UGV can achieve different control objectives by changing the main controller. The formation control protocol of UGVs is designed and its stability is analyzed. The effectiveness of the protocol is verified by numerical simulation. Finally, the designed control protocol is applied to the developed hardware test platform to verify the effectiveness of the experimental platform.
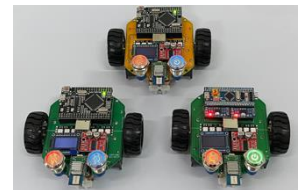
OS3-3 A Study of Weighted Average Method for Multi-sensor Data Fusion

Peng Lu[1], Fengzhi Dai[1,2]
([1] Tianjin University of Science and Technology, China),
([2] Tianjin Tianke Intelligent and Manufacture Technology CO., LTD, China)

With the development of sensor technology, multi-sensor data fusion has become an important research direction in the field of sensors. And parametric classification algorithms have become intensive in the field of multi-sensor data fusion. The weighted average method is the most important one among the parametric classification algorithms. This paper describes the composition and development of parameter classification algorithms, focusing on the process, steps and recent developments of the weighted average method, and uses the algorithm to fuse data from ultrasonic and infrared sensors. The simulation results prove that the weighted average method has a better fusion effect.
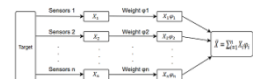
OS3-4 A Design of Wide-angle Open and Close Multifunctional Smart Windows

Zilong Liu, Fengzhi Dai*, Luqi Shen, Jiarun Xu, Longyu Gao
(Tianjin University of Science and Technology, China)

Current smart windows always have low intelligence and a few functions. And almost all kinds of traditional windows have the problem of inconvenient cleaning outside. The paper proposed a new mechanical structure design of the window, so that the window can be turned by nearly 180 degrees, which is convenient for cleaning the inside and outside of the window. In terms of intelligent systems, a variety of sensors combined with Internet modules are used to realize the remote intelligent control (turning with the wind, and automatically closing windows when there is no one at home when bad weather). The added child mode uses visual inspection to identify children. When a child is detected, the window will be automatically closed to prevent the child from climbing the window and falling from the building.

OS3-5 A Low-intensity Laser Control System Design

Yuhui Cheng, Fengzhi Dai (Tianjin University of Science and Technology, China)

Laser-assisted therapy has a good therapeutic effect on specific symptoms in clinical and experimental. This paper proposes a low-intensity laser control system design scheme, which is divided into the operation unit, control unit and work unit. The main control unit is based on the STM32F407ZGT6 chip design, the operating unit uses a DWIN 10.1-inch serial screen, and the working unit consists of 8 low-intensity laser generators. The system can control the power, frequency and working time of 8 laser generators at the same time, and has the function of automatically saving working parameters when the power is turned off.
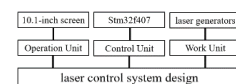
OS3-6 A Review of Machine Vision Based Fruit Recognition Applications

Tianyi Zhang, Fengzhi Dai (Tianjin University of Science and Technology, China)

Machine vision is widely used in various fields,   The main applications in the field of fruit picking are fruit identification, fruit quality detection, fruit ripeness detection and grading, etc. And fruit ripeness detection technology is important to improve the quality and market competitiveness of fresh and stored fruits. This paper focuses on the application of machine vision in fruit identification, fruit ripeness detection and grading in the past three years, and the application is more mature in many fruits such as citrus, blueberry, cherry, etc. It uses a number of algorithms to enable accurate identification of fruits and processing of their images to control the robotic arm for a variety of operations such as picking.

OS4 Intelligent Systems and Robotics -2-(5)
Chair Haokang Wen (Tianjin University of Science and Technology, China)
Co-Chair Jiaxin Li (Tianjin University of Science and Technology, China)

OS4-1 A Research on Image Dehazing Technology for Image Enhancement
Haokang Wen, Chang Sheng (Tianjin University of Science and Technology, China,)

Image defogging is to study the method of image enhancement in foggy weather with low definition and lighter color. Image defogging technology aims to improve image contrast and scene clarity, and has broad application prospects in the fields of target recognition, traffic navigation, and remote sensing. Three defogging algorithms in image defogging technology are introduced based on the current research status: global histogram equalization, local histogram equalization, and Retinex algorithm. This article introduces the main steps of the three algorithms and discusses the advantages and disadvantages of each algorithm. Finally, the processing results of these three algorithms are compared and comprehensively evaluated.

OS4-2 Design of Intelligent Daylily Picking Robot
Jiaxin Li (Tianjin University of Science and Technology, China)

The picking conditions of daylily are bad, and long-term picking is likely to cause extremely serious harm to human body, especially to hands. Through the research and summary of the biological characteristics of daylilies, this paper aims to develop a kind of intelligent picking mechanism with strong applicability. The main work includes: designing binocular recognition system for rapid segmentation and recognition of daylily; Workflow design of daylily intelligent picking robot; Software and hardware design of daylily picking control system.

OS4-3 50KN Compression Spring Fatigue Testing Machine Design
Peng Lu, Peng Jia (Tianjin University of Science and Technology, China)

Spring fatigue test is the key process of spring performance testing, especially for automotive suspension springs, train damping springs, engine valves and other critical parts of the spring, must do the reliability assessment of spring fatigue performance. Because the requirements of different springs are different, the frequency and amplitude used in the test also have different requirements. In this case, a compression spring fatigue tester was developed and designed to test the maximum number of cycles of a spring under a given failure condition by applying a cyclic variable load to the spring. Through the design of the compression spring fatigue testing machine, the test prototype is finally developed.
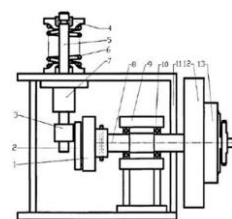
OS4-4 New Intelligent Unmanned Retail Shopping Container Design
Peng Lu, Yiting Gao (Tianjin University of Science and Technology, Tianjin, China)

During the COVID-19 epidemic, unmanned retail has seen new opportunities for growth. The common unmanned retail methods are vending machines and unmanned supermarkets, which have the disadvantages of low product variety and high store costs, respectively. In this paper, a new intelligent unmanned retail shopping container is designed, integrating unattended technology with the container. Through the two-dimensional code, electronic anti-theft, RFID and other technologies, designed to achieve the shopping process of the goods that are taken away, the whole data. At the same time, the designed shopping containers can be deployed closer to consumers, providing a safer and more convenient shopping experience for people.
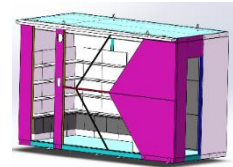
OS4-5 Java-based Dream Cloud ERP System - Inventory Management Subsystem Design and Implementation
Yiting Gao, Peng Lu (Tianjin University of Science and Technology, China)

With the continuous development of economy, large and medium-sized enterprises of heavy production tasks, more and more high to the requirement of inventory management. The traditional manual management will cause low efficiency of goods supply. The problems such as material management and data collection have become increasingly unable to meet the requirements of enterprise inventory management. The traditional inventory after making the decision need human convey, but the inventory management system as new way of management, inventory management system can provide managers with a convenient platform directly communicate need to complete the operation, task allocation directly down, people can be faster to implement.
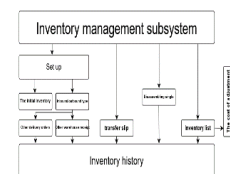
OS5 Intelligent Control (5)
Chair Yingmin Jia (Beihang University, China)
Co-Chair Weicun Zhang (University of Science and Technology Beijing, China)

OS5-1 Geometry Structure Oriented Nonlinear Internal Model Based Manifold Consensus
Yunzhong Song[1], Weicun Zhang[2], Fengzhi Dai[3], Huimin Xiao[4], Shumin Fei[5]
([1]Henan Polytechnic University, China), ([2]University of Science and Technology Beijing, China)
([3]Tianjin University of Science and Technology, China), ([4]Henan University of Economics and Law, China)
([5]South East University, China)

This note comes with manifold consensus based on nonlinear internal model. To be special, scheme demonstrated here is not necessary to inject the nonlinear internal model with additional extraneous augmented system. And this amazing result is made possible empowered by geometry structure, to be specific, Riemannian metric is employed to modeling the internal model of the nonlinear manifold. In case of completeness, the consensus of a first order linear agent and another one second order oscillator is provided to verify the suggested program.
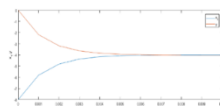
OS5-2 Consensus Control of Linear Discrete-time Multi-agent Systems with Limited Communication Data Rate

Jintao Hu, Yingmin Jia, Yaxin Li (Beihang University, China)

This paper investigates the consensus problem of linear discrete-time multi-agent systems with limited communication data rate and the cooperative-antagonistic interactions. A consensus control protocol is designed based upon a dynamic encoding-decoding mechanism. By means of the proposed control protocol, it is guaranteed that the agents can attain bipartite consensus if the signed graph is connected and structurally balanced, and besides the states of agents can reach zeros if the signed graph is connected but structurally unbalanced. Moreover, the clear form of the convergence rate is given. Finally, the numerous simulations are presented to illustrate the feasibility of the proposed control protocol.
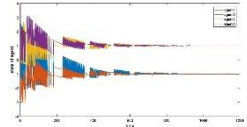
OS5-3 Formation control for rectangular agents with communication maintenance and collision avoidance

Yaxin Li, Yingmin Jia, Jintao Hu (Beihang University, China)

Formation control has many potential applications in various fields. This paper mainly discusses the rectangular agents, which is not often considered in other papers. Coordinate transformation is used to describe the location relationship between two agents. Obstacle function between agents, obstacle function between agents and obstacles are designed to ensure no collisions. Graph Laplacian is used to formation rotation. The distributed control protocol is designed to achieve desired formation with no collisions and communication maintenance between agents. Stability analysis proves the effectiveness of the algorithm.
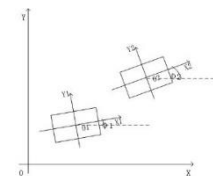
OS5-4 Research on Sign Language Recognition Algorithm Based on Improved R(2+1)D

Yueqin Sheng[1], Qunpo Liu[1], Naohiko Hanajima[2], Bo Su[1]
([1]Henan Polytechnic University, China), ([2]Muroran Institute of Technology, Japan)

Sign language is a significant communication tool for deaf or hearing-impaired people. The study of sign language recognition can promote the communication between deaf-mute people and normal people, which is of great importance to improve the quality of life of deaf-mutes. Meanwhile, as an important part of multi-mode human-computer interaction technology, the study of sign language recognition is also pushing the progress of intelligent human-computer interaction. Traditional sign language recognition methods can only solve the problem of sign language recognition with a certain data scale. These algorithms are complex and have low generalization. So this paper uses deep learning technology for sign language recognition. In this paper, an improved R(2+1)D model is proposed for isolated word recognition. This model separated the spatial convolution and temporal convolution, so that the optimization can be decomposed and the model can be optimized better. The validity of the proposed algorithm is verified on CSL data set.
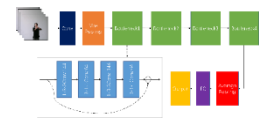
OS5-5 Directional Flocking of Multi-Agent system Caused by Limited Visual Field

Yongnan Jia[1], Yong Xie[2], Weicun Zhang[1]
([1]University of Science and Technology Beijing, China)
([2]The System Design Institute of Mechanical-Electrical Engineering, China)

Experiment evidence has proved that the visual field of each individual in biological swarms is usually non-omnidirectional. Therefore, we introduce limited visual field to the egalitarian flocking model. The directional flocking problem refers to the flocking problem that all the individuals are expected to move in a specified direction, which is decided by the leader. This paper mainly compared the limited-visual-field flocking model with the classic flocking model (that is the egalitarian one) from the point view of rate of convergence. Experimental results indicated that limited-visual-field flocking model is more efficient than the omnidirectional one for the directional flocking problem.
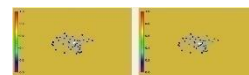
OS6 Bio-inspired Artificial Vision -Systems and Applications-(5)
Chair Shinsuke Yasukawa (Kyushu Institute of Technology, Japan)
Co-Chair Yuki Hayashida (Mie University/Osaka University, Japan)

OS6-1 The effect of preprocessing with Gabor filters on image classification using CNNs

Akito Morita, Hirotsugu Okuno (Osaka Institute of Technology, Japan)

Preprocessing of input images is one of the promising approaches for improving the accuracy in image classification using artificial neural networks. In this study, we investigated the effect of neuro-inspired preprocessing, such as Gabor filtering and opposite color contrast, on the classification accuracy of convolutional neural networks (CNNs). We compared the classification accuracy of CNNs with the following four types preprocessing: no preprocessing, Gabor filtering, opposite color contrast, and the combination of Gabor filtering and opposite color contrast. To eliminate the influence of the topology of the CNN, the average accuracy of multiple CNNs whose parameters (the number of layers and neurons and the size of kernels for convolution) were chosen randomly was evaluated. The STL10 dataset was used for training and evaluation. The results showed that Gabor filtering increased the classification accuracy, whereas the opposite color contrast did not increase the accuracy significantly.
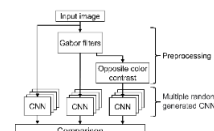
OS6-2 An image coding algorithm with color constancy using the Retinex theory and the Naka-Rushton equation

Shota Hisamitsu, Hirotsugu Okuno (Osaka Institute of Technology, Japan)

Illumination-independent coding of color information is required for a wide range of image recognition tasks because the lighting conditions strongly affect the apparent color of the object. In this study, we proposed an image-coding algorithm with color constancy based on the center / surround (C/S) retinex model and the Naka-Rushton equation; this equation was used in place of the logarithmic function used in the original C/S retinex model in order to encode the intensity information efficiently. Using images acquired under various lighting conditions, we compared the output of our algorithm with the gray world algorithm and the original C/S retinex algorithm. Using the same image set, we also investigated how the parameters of the Naka-Rushton equation affect the change in the color information output. The results suggested that setting the parameters depending on the image statistics around the region of interest could improve the performance of color discrimination.
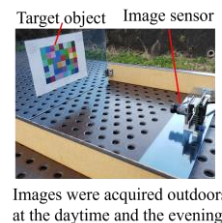
Images were acquired outdoors at the daytime and the evening

OS6-3 A fast image sensor system with an efficient multi-scale Gaussian filtering circuit

Yuuki Yamaji, Akito Morita, Hirotugu Okuno (Osaka Institute of Technology, Japan)

Real-time extraction of multi-scale visual features is one of the most important functions in robotic vision systems. In particular, many bio-inspired visual processing algorithms rely on multi-scale Gaussian and/or Gabor filters because the early stages of visual nervous system are modeled as such filters. Fast multi-scale Gaussian filtering is an essential component for implementing such functions. In the present study, we designed a multi-scale Gaussian filtering circuit whose coefficients of the standard deviation are selectable from any multiple of the square root of two. We also developed an image sensor system composed of a CMOS image sensor and a field-programmable gate array (FPGA) that contains the proposed filtering circuit. The system provided eight images whose resolution is 160 x 120 filtered by different scales of Gaussian at 156 frames / second.
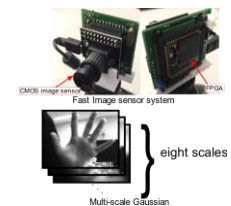
OS6-4 A robotic vision system emulating fixational eye movements and retinal sampling

Takanori Yotsumoto[1], Yuki Hayashida[2], Shinsuke Yasukawa[1]
([1]Kyushu Institute of Technology, [2]Mie University, Japan)

Recent studies on visual physiology have suggested that fixational eye movements contribute to the information processing function on the retina. In this study, we built a robotic vision system that emulates the characteristics of fixational eye movements and retinal sampling as an assistant tool for clarifying information processing through the collaboration of eye movements and neural circuits. The proposed robot vision system consists of two galvanometers, A field-programmable gate array (FPGA) board, and a high-speed, high-resolution camera. We measured the frequency response of this robot vision system and the results showed that it satisfied the requirements for emulating the frequency characteristics of biological eye movements. We also generated command signals in the FPGA to emulate biological eye movements, and confirmed the satisfactory operation of the system.
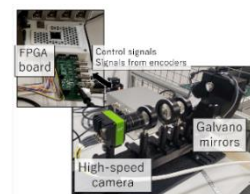
OS6-5 A bench-test system of the cortical prostheses utilizing retino-morphic spike as the driver signal of intracortical macrostimulation

Ryosuke Okada[1], Shinnosuke Ishikawa[2], Tetsufumi Tasaki[2], Tetsuya Yagi[2,3], Yuki Hayashida[1,2]
([1]Mie University, [2]Osaka University, [3]Fukui University of Technology, Japan)

Neuromorphic retinal emulators, which mimic computations and/or functional architectures in biological retinas, have been developed as hardware systems so that the information processing is executed in biological time scale, thereby making them available for the visual prosthetics for acquired blindness suffering from retinal diseases, like glaucoma or diabetic retinopathy. In this study, we developed a prototype hardware system of such a prosthetic, in which point-process spike signals from our previously developed retinal emulator were utilized for the electrical microstimulation applied to the primary visual cortex of the cerebrum. The system was consisted of the retinal emulator, a single board computer, a FPGA board, and our previously developed microstimulator ASIC chip connecting to multiple stimulating electrodes. By substituting the electrodes with a micro-LED array, the system operations were verified through bench tests, in which the spatial pattern of stimuli via 4096 output channels was controlled correspondingly to the visual scene.
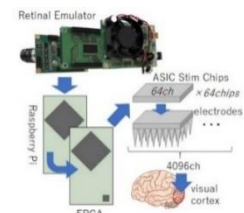
OS7 Media Information Processing, Music Recommendation and Artificial Intelligence (4)
Chair Yasunari Yoshitomi (Kyoto Prefectural University, Japan)
Co-Chair Masayoshi Tabuse (Kyoto Prefectural University, Japan)

OS7-1 Data expansion method by combining unnecessary sentence deletion and most important sentence addition

Tomohito Ouchi, Masayoshi Tabuse (Kyoto Prefectural University, Japan)

We are studying data expansion methods in automatic summarization systems. What has been found in the research to date is that the method of expanding the input article with unnecessary sentences deleted is the most effective of the extended methods. In the existing research, we have tried a method of adding most important sentences. In this research, we propose a method that combines the deletion of unnecessary sentences and the addition of most important sentences. We propose a hybrid method with two methods, one is to add important sentences first and the other is to add important sentences last.

OS7-2 Evaluation of a system that the reading of sentences by a voice synthesizer and the highlighting sentences

Sota Kobayashi, Masayoshi Tabuse (Kyoto Prefectural University, Japan)

It is generally known that there are individual differences in human cognitive function. For example, some people have an advantage over reading the text, while others have an advantage over hearing the words. We made a hypothesis; giving both visual and audio stimuli may make it easier for people to catch information. To test this hypothesis, we conducted an experiment. For the experiment, three indicators are set consisting of memory, understanding and concentration. Memory and understanding scores are measured by using a problem set given in a previous study. The problem set allows us to estimate the scores of verbatim memory and understanding. Concentration scores are estimated by the heart rate: previous study suggested a relationship between concentration and the heart rate. In this study, we made a system that realizes the reading of sentences by a voice synthesizer and the highlighting sentences. In the experiment using the system, we measured the difference in learning effect due to the difference in reading.
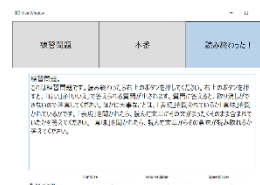
OS7-3 Mouse Cursor Control System using Eye Gaze and detection of eye opening and closing

Masayoshi Tabuse, Mana Fukumoto, Yasunari Yoshitomi, Taro Asada (Kyoto Prefectural University, Japan)

It is necessary to support of computer operation for a physically disabled person. One of the possible physical movements of the physically disabled person is Eye movement. Eye gaze and detection of eye opening and closing of a person makes it possible to operate a computer. In our system, a web camera, Gaze pointer, dlib C++ library and OpenCV library are used to recognize eye gaze and detect eye opening and closing. Changing the eye gaze, we can move a mouse cursor. Recognizing closed eye, we can carry out an operation of mouse click. In this paper, we evaluated the effect on operability due to the eye gaze and detection of eye opening and closing.

OS7-4 Music Recommendation System Driven by Facial Expression Recognition

Taro Asada[1], Motoki Kawamura[2], Yasunari Yoshitomi[1], Masayoshi Tabuse[1]
([1]Kyoto Prefectural University, Japan, [2]Fujitsu Limited, Japan)

We propose a system for music recommendation through an interaction between a user and a personified agent using facial expression recognition, synthesized voice and facial expression. Though expressing one of happy and neutral facial expressions, the user tells the system his or her evaluation on a song reproduced by the system. A happy facial expression means that he or she wants to listen to the song again, while a neutral facial expression means vice versa. The system exploits a series of his or her evaluations on previously recommended songs for deciding the next recommendation of song. The facial expression of the user is recognized using Face API. The effectiveness of the proposed system is verified.
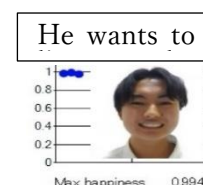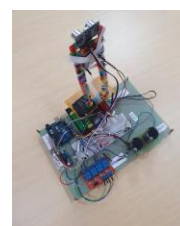
OS8 Intelligent Systems and Robotics -3 (4)-
Chair Tianyi Zhang (Tianjin University of Science and Technology, China)
Co-Chair Yiting Gao (Tianjin University of Science and Technology, China)

OS8-1 A Portable Electrocardiograph System Design based on STM32 Chip
Tianyi Zhang, Huating Liu (Tianjin University of Science and Technology, China)

ECG monitoring instruments occupy an important position in the medical field of application.It has a great reference value for the testing of basic cardiac functions and its pathological studies. For the shortcomings of conventional ECG monitoring instruments and equipment, which are large and not easy to carry, this paper designs a portable ECG monitor. In this paper, we designed a portable infrared induction heart rate measurement device, using STM32C8T6 as the core chip, to complete the extraction and processing analysis of ECG signals. The complete set thus composed can make basic diagnosis of the collected data and is successfully applied to daily life.

OS8-2 Design and Development of The Parking Space Autonomous Management System
Yiting Gao, Tianyi Zhang (Tianjin University of Science and Technology, China)

The article purpose is to change the manual or semi-manual management model that parking Spaces now have, so as to make the parking space management more standardized and more effective. This system used the Browser/Server architecture, JSP(Java Server Page) as the front r & d tool, SQL Server as the background data warehouse for r & d. The system key functions realized in the last system include: user registration and login, message block, parking reservation, change of login password, fee settlement block and parking information query. The design manufacture of this parking space autonomous management system can increase the effect of parking space management to a large extent, all reflecting the information period of the special good.
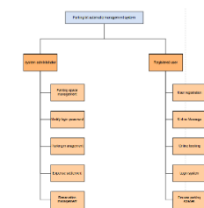
OS8-3 An Overview of Obstacle Avoidance Methods for Unmanned Vehicles
Peng Lu, Haokang Wen (Tianjin University of Science and Technology, China)

Autonomous obstacle avoidance is one of the popular research elements in the field of intelligent unmanned vehicles, and it is a key technology to realize the automatic travel of intelligent unmanned vehicles. This paper introduces the traditional algorithms and intelligent algorithms related to autonomous obstacle avoidance, and analyze the advantages and drawbacks of the corresponding algorithms. The development of the corresponding control strategies is also summarized and summarized in order to provide some reference for the research on obstacle avoidance of intelligent unmanned vehicles.
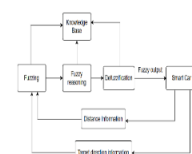
OS8-4 Synchronization of Novel 5D Hyperchaotic Systems

Hong Niu (Tianjin University of Science & Technology, China)

In this paper, synchronization of novel five-dimensional (5D) autonomous hyperchaotic systems is studied. The synchronization control law is proposed based on the center translation method. A structure compensator is formulated to make the mathematical model of the error system the same as that of the response system, and a linear feedback controller is designed via the Lyapunov stability theory to make the error system globally asymptotically stable at the origin. Thus, the two 5D hyperchaotic systems are synchronized. Some relevant numerical simulation results, such as the curves of the corresponding synchronization state variables and the errors, are given to illustrate the feasibility and effectiveness of the synchronization control law.

OS9 Robot Control (10)
Chair Yizhun Peng (Tianjin University of Science and Technology, China)
Co-Chair Junhui Yin (Tianjin University of Science and Technology, China)

OS9-1 Design of Analog Electromagnetic Gun Based on Arduino

Lintao Hu, Yizhun Peng (Tianjin University of Science and Technology, China)

The design of analog electromagnetic gun based on Arduino simulates the whole automated process of the electromagnetic gun discovering the target and launching the shell. The OpenMV camera on the simulated electromagnetic gun recognizes and determines the position of the target-shaped guide mark with a red radius of 20cm, then transmits the data to the Arduino to adjust the position of the simulated turret. The next step is that ultrasonic module measures the distance between the target-shaped guide and the turret before controlling the steering gear to rotate the barrel to the corresponding position. The shell in the barrel which is under the action of the magnetic field is accurately shot onto the target with a radius of 5cm on the ground.

OS9-2 A Design of Intelligent House Inspection Robot

Sicong Wang, Yizhun Peng (Tianjin University of Science and Technology, China)

Aiming at the social pain point that the tedious procedure of housing quality inspection leads to the consumption of a lot of manpower, an intelligent house quality inspection robot is designed. The robot can independently detect the quality of the walls and other structures of the indoor house. It is an intelligent detection robot based on Internet of things technology. The robot is independently developed and designed by our ROS operating system, combined with embedded devices and other devices. It can independently navigate and control by remote control. It can adapt to terrain in a variety of complex environments and obtain various environmental information for mapping. It can measure the defects of the house more quickly and accurately. It does not need to carry other large detection tools, which makes the detection process more convenient, saves a lot of manpower, and realizes the unmanned and intelligent detection.

OS9-3 A Design of Embedded Plate & Ball Control System Based on Machine Vision

Wendinig Luo[1], FuChen Zhao[2]
([1]Beijing Huadian Jingneng Energy Technology Co., China)
([2]Beijing University of Posts and Telecommunications, China)

The control system is an experimental device to track the position of the target object and control the trajectory of the sphere by the actuator-rudder-driven platform motion. The research content of this design includes image processing, machine vision, motion control and many other fields. In this paper, the mechanical structure of the plate & ball control system and the printed circuit board of the main controller are designed, and the PID-based control algorithm is designed on the basis of the ball control ability analysis and the real-time detection analysis of machine vision. On the hardware platform with good self-designed performance, the precise sphere coordinates are obtained by the Hough circle detection algorithm, and then the position and speed of the sphere are controlled by the PID controller.
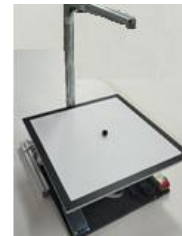
OS9-4 Design of Blood Circulation System of Medical Simulation Robot

Songyun Shi, Yang Ge, Chomgxu Guo, Yizhun Peng (Tianjin University of Science and Technology, China)

Medical robot is the most active direction in the research field of medical industry in recent years. Its development potential is very huge. It has greatly promoted the progress of modern medical equipment. The blood circulation system of our medical simulation robot can be used in medical universities, medical clinical training and even military fields. The robot adopts ROS robot operating system and FreeRTOS real-time operating system, and uses multi-sensor fusion data analysis to obtain the information in the blood sample and realize the simulation of blood circulation. Iit can simulate the touch of syringe in human injection. The whole medical process is optimized.

OS9-5 A Design of Dynamic Exoskeleton for Self-learning Human Movements

Qingliang Liu, Yucheng, Pengyu Yao, Dechao Wang,Yizhun Peng
(Tianjin University of Science and Technology, China)

In order to make the athletes more flexible and simple in the movement training, this project designed a kind of intelligent exoskeleton for the athletes to learn and complete a set of fixed movements with a higher efficiency in the training. In order to optimize the user's sports experience and adapt to more sports scenes, the product is divided into three parts: embedded device, mobile phone client and background server. The smart exoskeleton can be mechanically worn only by connecting the leg bandage and hand bandage to the human body. A single person can be completed, more convenient. It is a multi-degree-of-freedom humanoid robot system that can follow the movement of human limbs in real time. The equipment sets a series of standard movements, which leads human to repeat exercises and slowly forms muscle memory. The main target of the design is the people who want to quickly and accurately achieve the purpose of action learning.

OS9-6 Design of Autonomous navigation building Climbing and Handling Robot Based on SLAM

Linhui Chen, Junjie Tai, Yizhun Peng (Tianjin University of Science and Technology, China)

When there is no elevator at the station and airport or the elevator is crowded, the ramp of baggage checking is steep, the weight of luggage package is too heavy, it takes time and effort, and it is very easy to knock against and cause damage to the contents of the package. Our climbing robot carries out autonomous navigation based on visual SLAM. Equipped with ROS robot operating system, it adopts laser SLAM mapping navigation technology and tracks as running parts, which is suitable for various terrains. The adoption of binocular vision, can be more accurate analysis of the surrounding environment. The robot is equipped with MPU9250 attitude sensor, which is convenient for solving robot attitude. Jetson Nano is used as the upper computer and STM32F429 as the lower computer.
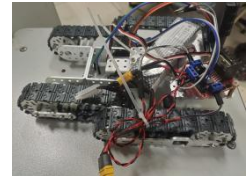
OS9-7 Simulation Research on Automatic Navigation of Indoor Wheelchair

Peng Shi, Yizhun Peng (Tianjin University of Science and Technology, China)

A new auto-navigation wheelchair based on ROS system is proposed to deal with the global aging and the low behavioral ability of the elderly. Lidar is used to locate and map the active area using gmapping algorithm. Real-time map information is transmitted to the processor by the camera and lidar working together. Automatic navigation is completed by A* algorithm calculation. Important information points are marked by QR code and precisely positioned by camera recognition, which enables wheelchair to have automatic navigation function. It can help older people move safer and more freely at home; It can also be applied to nursing homes to reduce the pressure of nurses and centralize management of the elder.

OS9-8 Design of a Humanoid Dance Robot for Dancing Baduanjin

Zhuofan Xu, Ruitao Li, Binfu Zhong, Yizhun Peng (Tianjin University of Science and Technology, China)

This paper introduces a humanoid robot which consists of 16 servo motors driving joint and adopts STM32 as the main control chip and dual mode Bluetooth3.0/4.0BLE+EDR wireless control.By programming, the motor of humanoid robot can reach the specified space position and attitude at the specified time.At the same time, digital closed-loop control PID algorithm and synchronous compensation algorithm are used to modify and optimize the Angle of the servo motor in real time, and the designed action is vividly displayed.

OS9-9 Design of Intelligent Shading System Suitable for Parenting Products
Yihan Yan, Songyun Shi, Yaxin Shen, Yizhun Peng (Tianjin University of Science and Technology, China)

With the development of science and technology, if you want to provide a more safe and healthy growth environment for babies, simple human protection is far from enough. And as smart home is gradually accepted by the public, smart home does bring people a more convenient life In daily life, proper exposure to the sun can help nutrients be quickly absorbed and used, so that babies can better explore this new world, but direct sunlight will bring great harm to babies' eyes This product is an intelligent shading system, which can be connected with the smart home system and the Internet. Based on specific seasons, time periods and different geographical locations, the position of the sun and light intensity can be determined, so as to adjust the shading Angle in time, so that babies can bask more scientifically.
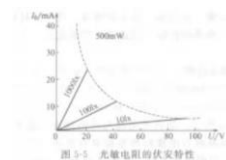
OS9-10 Design of Intelligent Personalized Nutrition Supplement Machine
Xinpeng Yang, Sidan Liu, Rui Li, Junhui Yin, Yizhun Peng
(Tianjin University of Science and Technology, China)

Reasonable nutritional supplement is the necessity for growth and development of living organisms. Residents need various nutrients daily to maintain bodies. However, in the post-epidemic era, people's physical and mental pressure has increased due to the fast life pace, and most Chinese residents are sub-healthy. To improve the current incomplete and untimely citizen nutrition supplement mode, this work uses big data, artificial intelligence and Internet of things to design an unmanned intelligent personalized nutrition supplement machine. Combining individual body data automatically, the machine can prepare exclusive nutritional supplement drinks timely, avoid crowd contact and support the citizen health quality improvement with effective software and hardware .

OS10 Software Development Support Method (4)
Chair Tetsuro Katayama (University of Miyazaki, Japan)
Co-Chair Tomohiko Takagi (Kagawa University, Japan)

OS10-1 N-Switch and All-Path Test Coverage Criterion for Extended Finite State Machine
Tomohiko Takagi[1], Koichiro Sakata[1], Kouichi Akiyama[2]
([1]Kagawa University, Japan), ([2]Japan WillTech Solution Co., Ltd., Japan)

EFSM (Extended Finite State Machine) enables engineers to define the expected behavior of software from the aspect of not only state transitions but also actions on the state transitions. Test cases are usually created from EFSM models so as to satisfy a test coverage criterion called N-switch. However, it is originally designed for FSM, and actions are not taken into account in it. To address this problem, we propose a new test coverage criterion for EFSM. Our criterion requires that (i) test cases cover all the successive state transition sequences of specified length, and also (ii) the test cases cover all the paths on control flow graphs of actions that accompany each of the successive state transition sequences. (i) and (ii) are the characteristics of N-switch and AP (All-Path test coverage criterion), respectively.
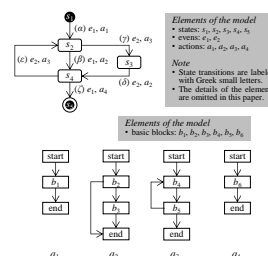
OS10-2 Proposal of a Method to Generate Classes and Instance Variable Definitions in the VDM++ Specification from Natural Language Specification

Kensuke Suga[1], Tetsuro Katayama[1], Yoshihiro Kita[2], Hisaaki Yamaba[1], Kentaro Aburada[1], Naonobu Okazaki[1]
([1]University of Miyazaki, Japan), ([2]University of Nagasaki, Japan)

VDM is one of methodology on the formal methods to write the specification without ambiguity. Writing VDM++ specification is difficult. Our laboratory proposed a method for automatically generating VDM++ specifications from natural language specifications using machine learning. However, the existing method is not useful because it only supports type definitions and constant definitions in the VDM++ specification. This paper proposes a method to generate classes and instance variable definitions in the VDM++ specification from natural language specification. The superordinate and subordinate relationships between words are quantified, and then they are used as new parameters for machine learning. It is confirmed that the proposed method gave more useful results than the existing method.
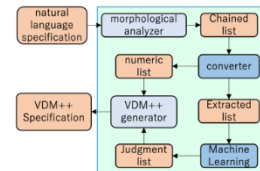
OS10-3 Expansion of Application Scope and Addition of a Function for Operations into BWDM to Generate Test Cases from VDM++ Specification

Takafumi Muto[1], Tetsuro Katayama[1], Yoshihiro Kita[2],
Hisaaki Yamaba[1], Kentaro Aburada[1], Naonobu Okazaki[1]
([1]University of Miyazaki, Japan), ([2]University of Nagasaki, Japan)

Generating test cases from formal specification descriptions VDM++, which is a method for the ambiguity of specifications, is time-consuming and labor-intensive. Therefore, we developed BWDM, which is an automatic test case generation tool for VDM++ specifications, in our laboratory. However, the existing BWDM does not support type definition blocks and conditional expressions for invariant conditions, pre-conditions, and post-conditions. Moreover, it cannot generate test cases for operation definitions that manipulate a state of objects. Therefore, to improve the usefulness of BWDM, this research extends BWDM to solve the above three problems. Consequently, it is confirmed that the extended BWDM can save about 17 minutes in generating test cases compared to test cases generation by hand.
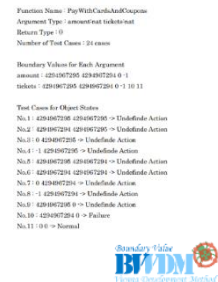
OS10-4 Proposal of Gamma which is a spatial data sharing distributed MQTT system

Takahiro Ueda[1], Tetsuro Katayama[1], Yoshihiro Kita[2], Hisaaki Yamaba[1], Kentaro Aburada[1], Naonobu Okazaki[1]([1]University of Miyazaki, Japan), ([2]University of Nagasaki, Japan)

This paper proposes Gamma, which is a new distributed MQTT system, to improve the usefulness of distributed MQTT systems for sharing spatial data. Gamma that adds a Manager to the previous study is implemented with five functions. In the experiment, it was found that Gamma can process more messages than a single MQTT broker. It is confirmed that Gamma achieves scalability by increasing the number of Gateways and distributed MQTT brokers. Furthermore, it is confirmed that the efficiency of the distributed MQTT system can be improved by setting the responsibility area of Gateways so that its load is not unevenly distributed to a specific Gateway.
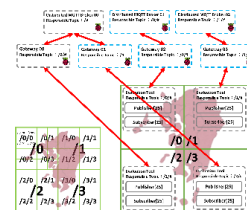
OS11 Applications of deep learning algorithms (9)
Chair Xiaoyan Chen (Tianjin University of Science and Technology, China)
Co-Chair Shiming Wang (Tianjin University of Science and Technology, China)

OS11-1 Human-vehicle detection based on YOLOv5

Zhihui Chen[1], Xiaoyan Chen[1], Xiaoning Yan[2], Shuangwu Zheng[2]
([1]Tianjin University of Science and Technology, China), ([2]Shenzhen Softsz Co. Ltd., China)

With the continuous improvement of social development level, traffic has become complicated. Therefore, the detection of people and vehicles becomes important. There are many application scenarios for human-vehicle detection, such as autonomous driving and transportation. This paper mainly introduces the research status of human-vehicle detection, analyzes the advantages and disadvantages of various current target detection algorithms, and focuses on YOLOv5 algorithm. Because the YOLOv5 model is much smaller than YOLOv4, and also has strong detection ability. Finally, YOLOv5 is used to carry out human-vehicle detection experiments. The results the detection accuracy is improved slightly.
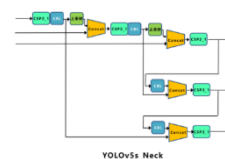
OS11-2 Low light enhancement CNN Network based on attention mechanism

Xiwen liang[1], Xiaoyan Chen[1], Hao Feng[1], Xiaoning Yan[2], Nenghua Xu[2]
([1]Tianjin University of Science and Technology, China), ([2]Shenzhen Softsz Co. Ltd., China)

Low-light enhancement is a challenging task. With the image brightness increasing, the noises are amplified, and with the contrast and detail increasing, the false information is generated. In order to solve this problem, this paper proposes a novel end-to-end attention-guided method (A-MBLLEN) based on multi-branch convolutional neural network. The proposed network is composed with enhancement module (EM) and Convolutional Block Attention Module (CBAM). The attention module can make the CNN network structure gradually focus on the weak light area in the image, and the enhancement module can fully highlight the multi-branch feature graph under the guidance of attention. In this manner, image quality is improved from different aspects. Extensive experiments demonstrate that our method can produce high fidelity enhancement results for low-light images quantitatively and visually.
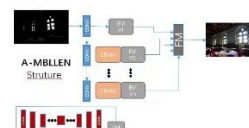
OS11-3 Fruit Recognition Based on YOLOX

Keying Ren[1], Xiaoyan Chen[1], Wangzi Chen[1], Xiaoning Yan[2], Dongyang Zhang[1]
([1]Tianjin University of Science and Technology, China), ([2]Shenzhen Softsz Co. Ltd., China)

Pattern recognition is an urgent problem to be solved in the field of computer vision. In this paper, the network of fruit recognition based on YOLOX is studied. Due to the problem of slow training speed and low accuracy in the classical algorithms, the de-coupling detection head is optimized in YOLOX to overcome the above shortcomings. In terms of data enhancement, a new method combining Mosaic and MixUp is proposed. Through experimental verification, the method proposed in this paper has a great improvement over related algorithms such as YOLOV5, the accuracy is 98.6%, which is increased 5.2%.

OS11-4 An improved small target detection method based on YOLOv4

Xia Miao[1], Xiaoyan Chen[1], Keying Ren[1], Zichen Wang[1], Xiaoning Yan[2], Yue Sun[2]
([1]Tianjin University of Science and Technology, China), ([2]Shenzhen Softsz Co. Ltd., China)

In order to improve the efficiency and accuracy of small target detection in current traffic flow, this research proposes an improved YOLOv4 framework and applies it to small target detection task. A new small target-friendly 4-fold down-sampling residual is added between the second and third residual blocks of CSP Darknet-53 block to improve the detection accuracy of small target. The novel YOLOv4 model is optimized by above strategy. Compared with the original network, the modified framework can significantly improve the recall rate and average detection accuracy of small target.

OS11-5 Yolov5-DP: A new method for detecting pedestrian aggregation

Kunzhi Yang[1], Xiaoyan Chen[1] Xiaoning Yan[2], Dashuo Wu[2]
([1]Tianjin University of Science and Technology, China), ([2]Shenzhen Softsz Co. Ltd., China)

In this paper, a novel network Yolov5-DP (Yolov5-DBSCAN-P) is proposed. Deep separable convolution and ACON-C activation function are added into Yolov5 network to improve the detection accuracy of pedestrians. Firstly, DBSCAN-P is used as the clustering detector to detect pedestrians in the area. Secondly, the depth-separable convolution is used to replace the common convolution in Yolov5. Finally, the loss function Swish is improved to ACON to increase the model speed and reduce the model size. The Yolov5-DP network is tested on the public dataset MOT20Det. The experimental results show that good detection results and accurate aggregation detection results are obtained.

OS11-6 Flame Recognition based on Yolov5 Algorithm

Kunzhi Yang[1], Xiaoyan Chen[1] Xiaoning Yan[2], Dongyang Zhang[2]
([1]Tianjin University of Science and Technology, China), ([2]Shenzhen Softsz Co. Ltd., China)

To address the problem of low accuracy and speed of flame detection, this paper proposes an improved YOLOv5 for flame detection. The new network is based on YOLOv5 by changing the loss function to DIoU(Distance Intersection over Union). Through introducing a large number of training data sets, it is hoped to improve the object detection accuracy. The experimental results show that the proposed YOLOv5 algorithm is effective with higher accuracy and faster detection for different flames.

OS11-7 Research on face detection algorithm based on improved YOLOv5

Zhen Mao[1], Xiaoyan Chen[1], Xiaoning Yan[2], Yuwei Zhao[2]
([1]Tianjin University of Science and Technology, China), ([2]Shenzhen Softsz Co. Ltd., China)

Face detection technology is one of the research hotspots in the field of deep learning in recent years. Aiming at the problems of slow detection speed and low accuracy of various target detection algorithms, this paper proposes an improved target detection algorithm based on YOLOv5. By introducing lightweight network, changing the depth and width of YOLOv5 network structure and reducing the number of model parameters, the network reasoning speed can be greatly accelerated. At the same time, the method uses Acon adaptive activation function to further improve the accuracy of face detection. Experimental results show that the improved algorithm has faster detection speed and higher detection accuracy than the traditional algorithms.

OS11-8 Visibility analysis based on a novel A-VGGNet network

Zhen Mao[1], Xiaoyan Chen[1], Xiaoning Yan[2], Shuangwu Zheng[2]
([1]Tianjin University of Science and Technology, China). ([2]Shenzhen Softsz Co. Ltd., China)

In recent years, visibility analysis through deep learning processing and analysis of video images for different places has become a hot research topic that attracts people's attention. A new deep learning model (A-VGGNet) is proposed to evaluate the visibility of real scenes. The model is constructed on the basis of the VGG classification model, and the classification accuracy of the deep learning model is improved by adding an attention mechanism. The experimental results show that the training success rate is 97.62%, the verification set test accuracy rate is 75.05%, and the test set classification accuracy rate is 85.05%. The proposed model has a good effect on the accuracy evaluation and classification of visibility.
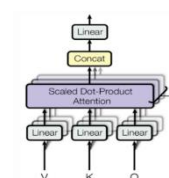
OS11-9 Price Prediction of Diamonds

Xiran Wen, Qiqi Xu, Zirui Su, Jiayi Fang (The Chinese University of Hong Kong, China)

The experiment aimed at price prediction based on diamond dataset which contains 53940 rows of information. The model is constructed based on linear regression model with the lowest estimated test error among all methods including tree and nonlinear models. The experimental results show that the mean square error for the training dataset and validation dataset are 592182.6 and 603833.2 respectively, and the R^2 reached 98%. The test MSE is 631947. The proposed model can well predict diamond prices.
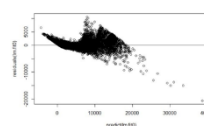
OS12 Intelligent Measurements and Control Systems (8)
Chair Xiaoyan Chen (Tianjin University of Science and Technology, China)
Co-Chair Shiming Wang (Tianjin University of Science and Technology, China)

OS12-1 Research on an AGV path planning method
Zhihui Chen, Xiaoyan Chen, Shiming Wang (Tianjin University of Science and Technology, China)

AGV is an acronym for Automatic Guided Transport Vehicle. At present, the key technologies of AGV mainly include navigation and positioning technology, path planning technology, multi-AGV coordinated control technology and multi-sensor information fusion technology, etc. This paper studies A* algorithm in path planning. The A* algorithm can find the shortest path between two points. It mainly studies the principle of A* algorithm and simulates it in Matlab. By comparing the path length of ant colony algorithm and A* algorithm in Matlab grid graph, the excellent performance of A* algorithm is proved.

OS12-2 Boiler level measurement and control system
Xiwen Liang, Shengli Sun, Xiaoyan Chen (Tianjin University of Science and Technology, China)

This paper develops a boiler level control system to measure and control boiler level easily. This level control system applies PID control algorithm in SIEMENS S7-300PLC, uses ladder diagram and statement table programming, and completes variable connection and screen editing in MCGS monitoring system. The PLC boiler level control system is completed by establishing the system mathematical model, designing the level control algorithm, and verifying the simulation. Through debugging, modifying parts of the parameters, the control effect of the control system achieve satisfied expectation.
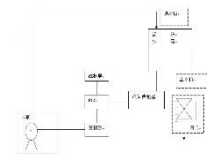
OS12-3 Recurrence quantification and time-frequency analysis of two-phase flow patterns
Keying Ren, Xiaoyan Chen , Meng Du (Tianjin University of Science and Technology, China)

Two phase flow often occurs in industrial production. If it is not detected in real time, it will do great harm to industrial production. In this paper, a method combining recurrence quantitative analysis and time-frequency representation is proposed to identify the flow patterns of the Gas-liquid flow. From the construction of the experimental device to the collection of conductance fluctuation signal of two-phase flow, the recurrence plot and WVD distribution map are drawn by MATLAB which are used in the final flow pattern analysis of two-phase flow. Experimental results show that our method can accurately identify the flow pattern of two-phase flow.
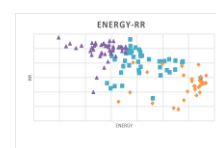
OS12-4 Application of Deep learning in automatic driving
Wei Su, Xiaoyan Chen (Tianjin University of Science and Technology, China)

With the continuous development of science and technology, the field of artificial intelligence has become a research hotspot, especially deep learning, which has attracted much attention from all walks of life. Starting with the automatic driving solution, this paper mainly expounds the important role and technical route of the deep learning applications, and finally looks forward to the development direction and application of automatic driving technology based on deep learning.

OS12-5 An intelligent home security system based on STM32

Wei Su[1], Xiaoyan Chen[1], Guangyong Xi[2]

([1]Tianjin University of Science and Technology, China), ([2]Zhengzhou University of Light Industry, China)

Based on STM32F103C8T6 host control chip, this paper completes the design and development of an intelligent home security system combined with various hardware modules, cloud server and android app. The system integrates OLED display screen, buzzer, human infrared, Wifi and other modules. The serial port is connected with ZigBee coordinator. The terminal equipment with temperature, humidity and smoke sensors is adopted to monitor the environment, and the relays and stepping motors are designed to control the equipment at home by simulation. The access control system takes STC89C52 as the core, and integrates the functions of photographing module and steering gear simulation door opening. Android app uses socket technology to complete remote data communication through Alibaba cloud server and indoor security system. After testing, the system runs stably and has good performance.
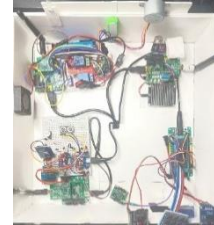
OS12-6 Design of smart bracelet based on STM32 microcontroller

Xia Miao, Xiaoyan Chen, Jianliang Li (Tianjin University of Science and Technology, China)

With the development of electronic information technology, the demand for high-precision and convenient electronic detection equipment for biomedical signals goes straightly high. Heart rate and steps counting are two important indicators of the human body. Based on this, this design studies an intelligent bracelet with health monitoring system, which can detect human movement state and steps counting, measure and analyze the heart rate, and connect wirelessly through Bluetooth module. A STM32 microcontroller is used to collect and analyze the information of motion state, heart rate and step quantity, and then send them to the APP, which is developed based on Android and displayed through Bluetooth module. The users can change their lifestyle by above parameters. Smart bracelets can play a role in reducing the risk of disease.

OS12-7 Design of material conveying and automatic sorting control system based on PLC

Qian Wang[1], XiaoYan Chen[1], Shengmin Cao[2]

([1]Tianjin University of Science and Technology, China), ([2]TangShan College, China)

The automatic sorting technology is widely used in all walks of life, such as logistics distribution center, post office, mining, port, etc. It can replace human to do a lot of monotonous reciprocating or high-precision work, in order to liberate people's hands to do more challenging and innovative work, and greatly improve work efficiency. This design uses programmable controller PLC and configuration software to design an automatic sorting control system. The PLC and MCGS present a friendly man-machine interface and powerful data management functions. The simulation results show that the system has high sorting efficiency and stable performances.

OS12-8 Image reconstruction based on ResV-Net for electrical impedance tomography
Qian Wang, ZiChen Wang, Di Wang, XiaoYan Chen (Tianjin University of Science and Technology, China)

Electrical impedance tomography (EIT) is a nonlinear and ill-posed inverse mathematical problem. Due to the above problem, the reconstruction image suffers from the serious artifacts. To overcome shortcomings, we proposed a residual V-shaped deep convolutional neural network (ResV-Net). It consists of feature extraction module and image reconstruction module which are optimized by ResBlock. The residual connection method can effectively increase the number of forward information flow and reverse gradient flow in deep CNN, and alleviate the problem of non-convergence caused by gradient vanishing. The simulation and experimental results show that the ResV-Net has better visualization effect than the related imaging method.
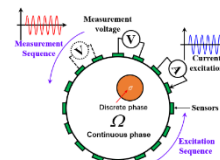
OS13 Mathematical Informatics (5)
Chair Takao Ito (Hiroshima University, Japan)
Co-Chair Makoto Sakamoto (University of Miyazaki, Japan)

OS13-1 Basic Study on Design Tool of Hula Costumes
Taketo Kamasaka[1], Kodai Miyamoto[1], Makoto Sakamoto[1], Satoshi Ikeda[1], Amane Takei[1], Kenji Aoki[1],
Tsutomu Ito[2], Takao Ito[3]
([1]University of Miyazaki, Japan), ([2]National Institute of Technology, Ube College, Japan)
([3]Hiroshima University, Japan)

Miyazaki Prefecture has a large hula population, probably due to its similarity to Hawaii in mythology and climate. On the other hand, many hula costumes are handmade, and it costs tens of thousands of yen to produce an original design. Therefore, we are developing a 3D computer-aided design (CAD) system for hula costumes, based on the idea that it is possible to reduce the number of failures by checking the behavior of the fabric when dancing in the designed costume before making it. There are some research examples on ordinary apparel CAD, but there is no precedent specific to hula costumes.

OS13-2 Basic Study on the Use of XR Technology to Support Science Education

Kodai Miyamoto[1], Taketo Kamasaka[1], Makoto Sakamoto[1], Masahiro Yokomichi[1], Satoshi Ikeda[1], Amane Takei[1], Tsutomu Ito[2], Takao Ito[3]
([1]University of Miyazaki, Japan), ([2]National Institute of Technology, Ube College, Japan),
([3]Hiroshima University, Japan)

According to the results of a survey on science teaching in 2016, the percentage of students who answered that they like science is lower than other subjects. However, more than 80% of students said that they like experiments and observations. In addition, a 2019 survey on smartphone penetration showed that about 90% of students are familiar with the technology. Also, XR technology has made remarkable progress in recent years. Based on the above, I conducted this research because I thought that creating a simulation application using XR technology with smartphones would change the way we think about science classes. In this paper, we have developed a simulation application for science experiments. The subjects were asked to experience the created application and answer a questionnaire. As a result, the average score was 4 out of 5, which was not a bad result. At the same time, however, we found a problem. The problem was that since this was a simulation application, the user experience was not very good. So we wanted to make it a little easier to use. While improving the problems, I would like to create apps for other fields as well.
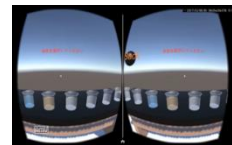
OS13-3 Analysis of 5x5 board Quoridor

Takuro Iwanaga, Makoto Sakamoto, Takao Ito, Satoshi Ikeda (University of Miyazaki, Japan)

In this paper, we analyze Quoridor using retrograde analysis. *Quoridor* is a 2 or 4-player intuitive strategy game designed by Mirko Marchesi and published by Gigamic Games. In this study, we will analyze the game for two players. In this case, Quoridor is classified as finite two-person zero-sum games, so it is always classified as either a must-win game, a must-win game, or a tie game. In this case, Quoridor is finite two-person zero-sum games, so it can be classified as either a must-win game, a must-lose game, or a tie. First, we analyze the game with 25 squares (5x5) and one board each (originally 81 squares and 10 boards each). After that, we will increase the number of boards and squares to achieve the regular version of the analysis.
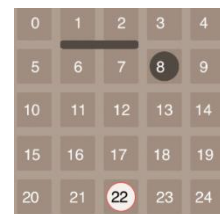
OS13-4 A perfect play in 4×12 board of Othello

Tomoyasu Toshimori, Makoto Sakamoto, Takao Ito, Satoshi Ikeda (University of Miyazaki, Japan)

In 1993, mathematician Joel Feinstein discovered that White would win in a 6x6 Othello if both players did their best. In 2015, Takeshita worked on the analysis of the reduced Othello and succeeded in the complete analysis of 4x4, 4x6, 4x8, and 4x10 boards. A complete analysis of the 4x12 board predicted that the search space was about 10^4 times larger than the 4x10 board. Therefore, Takeshita tried to reduce the search space by referring to the perfect play of 4x10 board. As a result of searching after the 7th move when the procedure up to the 6th move on the 4x12 board was the same as that on the 4x10 board, it was confirmed that Black would win. In this paper, we will perform a complete analysis of the 4x12 board Othello before the 7th move.
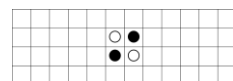
OS13-5 Parallel full-wave electromagnetic field analysis based on domain decomposition method
Amane Takei, Kento Ohnaka, Makoto Sakamoto (University of Miyazaki, Japan)

In this presentation, a parallel full-wave electromagnetic field analysis code based on an iterative domain decomposition method is explained that is named ADVENTURE_Fullwave. A stationary vector wave equation for the high-frequency electromagnetic field analyses is solved taking an electric field as an unknown function. Then, to solve subdomain problems by the direct method, the direct method based on the LDL^T decomposition method is introduced in subdomains. The simplified Berenger's PML is introduced which these eight corners are given the average value of all PML's layers. And, we show a numerical example of a microwave. More detail will be shown in the conference.
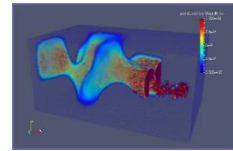
OS14 Biomedical Systems (4)
Chair Taro Shibanoki (Okayama University, Japan)
Co-Chair Hideyuki Tonooka (Ibaraki University, Japan)

OS14-1 A Mutual Control Method for a Multi-layered Non-contact Impedance Model-based mobile robots
Masaru Sasaki[1], Taro Shibanoki[2], Hideyuki Tonooka[1], Toshio Tsuji[3]
([1]Ibaraki University, Japan), ([2]Okayama University, Japan), ([3]Hiroshima University, Japan)

This paper proposes a mutual control method for multi-layered non-contact impedance model-based mobile robots. In the proposed system, the motion priority is set to the robot, and the stiffness, viscosity, and inertia parameters of the non-contact impedance model are changed appropriately according to the priority value, so that the robots can avoid collision with each other and obstacles at the same time. In the experiment, two mobile robots, including one controlled by EMG signals, were prepared and operated to intersect. The other mobile robot automatically stopped and resumed its movement in response to EMG-controlled robot with the high priority, indicating that the proposed method can be used to control multiple robots.
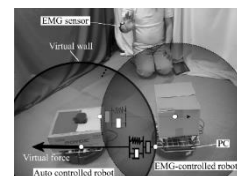
OS14-2 Relationship Between Delay Time and Sensation in Tactile Feedback for Myoelectric Prosthesis
Taro Shibanoki (Okayama University, Japan), Kosuke Jin (Ibaraki University, Japan)

In this paper, we aim to develop a new tactile feedback method for myoelectric prosthetic hands and model the relationship between delay time and sensation in vibration stimulation. For myoelectric prosthetic hands, tactile sensation can be expressed by vibrating an oscillator attached to the socket based on information obtained from tactile sensors attached to the prosthesis's fingertips. In this case, if there is a time gap between the sensory input and the stimulus, there is a possibility of causing discomfort. Therefore, in the experiment performed, a delay time, D [s], is set between the start of contact with an object and the start of vibration using a tactile sensor and conducted NRS evaluation. The results showed that the discomfort was generated up to D = 0.8 [s] and then decreased according to the delay time. The results showed that the discomfort was induced by controlling the timing of the vibration stimulus.
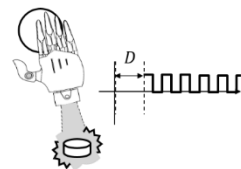
OS14-3 Effects of Tactile Stimulation Near the Auricle on Body Sway During Foot Stamping

Masaya Tadokoro[1], Taro Shibanoki[2], Hideyuki Tonooka[1]
([1]Ibaraki University, Japan), ([2]Okayama University, Japan)

This paper describes the effects of tactile stimulation near auricles on body sway in during foot stamping. The system measures center of pressure, acceleration of upper body, and whole-body movements by skeleton tracking with a depth camera while the subject performs foot stamping on the stabilometer, and extracts evaluation indices based on four perspectives: 1. the amplitude, 2. the variation, and 3. rhythm of body sway, and 4. the correlation of each limb. In the prototype experiment conducted with one healthy mail, the body sway during foot stamping for ten trials in non-stimulus condition is compared with that for two trials in stimulus condition that the constant tactile stimulus is applied. As a result, the variation of the movement of lower limb and upper body sway were significantly reduced. This result implies that applying the constant tactile stimulation near both of auricles may be effective in stabilizing posture during foot stamping.
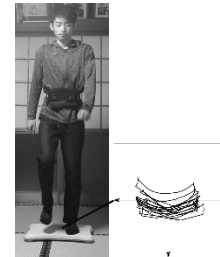
OS14-4 A Monitoring System of a Hamster Based on Video Image Analysis

Yugo Yamazaki[1], Taro Shibanoki[2], Hideyuki Tonooka[1]
([1]Ibaraki University, Japan), ([2]Okayama University, Japan)

This paper proposes a monitoring system of a hamster using a video camera. The proposed system first processed the video image taken from the top of the cage, and then extract features related to posture information and internal state. These features are used to discriminate between daily activities and other activities using machine learning technique. This allows the system to alert when the hamster behaves differently from its daily routine. In the experiments, we analyzed the daily behaviors of hamsters using the proposed system, and showed that the behaviors of hamsters change when stimuli are given from outside the cage, and that the system may be able to discriminate them appropriately.

OS15 Artificial Intelligence for Embedded Systems and Robotics (5)
Chair Hakaru Tamukoh (Kyushu Institute of Technology, Japan)
Co-Chair Takuya Nanami (University of Tokyo, Japan)

OS15-1 INT8 Activation Ternary or Binary Weights Networks

Ninnart Fuengfusin, Hakaru Tamukoh (Kyushu Institute of Technology, Japan)

In this paper, we propose binary or ternary weights 8-bit integer activation convolutional neural network. This model is designed to fit as a middle ground between the 8-bit integer and low-bit (1-bit or 2-bit) quantized models. We discover that conventional low-bit quantization techniques (i.e., BinaryConnect and Ternary Weight Network) can be utilized with 8-bit integer quantization without any fractions. Based on these methods, we evaluate our model with the VGG16-like model and CIFAR10 dataset. Our model provides competitive results to the general floating-point model.
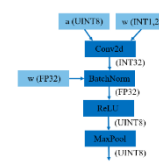
OS15-2 A parameter tuning method for PQN model

Daimon Sakai, Takuya Nanami, Takashi Kohno (University of Tokyo, Japan)

A piecewise quadratic neuron (PQN) model is a spiking neuron model that can be efficiently implemented on digital arithmetic circuits. In addition, this model can reproduce a variety of neuronal activities precisely with optimized parameter sets. In previous studies, we have optimized the parameters using meta-heuristic methods, which required a lot of computational time. In this paper, we propose a parameter estimation method that takes into account the mathematical structure of the model and reproduces the electrical activities of a targeted neuron with less computational time. We expect that this method can be used to construct silicon neuronal networks that faithfully replicate the nervous system.
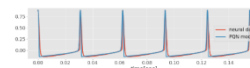
OS15-3 Hardware Development of Edge-Preserving Bubble Image Conversion in High-level Synthesis

Jiang Qin, Akira Yamawaki (Kyushu Institute of Technology, Japan)

The non-photorealistic rendering, NPR, is widely used in social networking service on the mobile device. To realize a real time NPR with low power making battery life of mobile device longer, we attempt to develop hardware module by using high-level synthesis, HLS, converting software to hardware automatically. This research focuses on edge-preserving bubble image, EPB, converting photos into image like filled with bubbles. We proposed a software description method for EPB algorithm so that HLS can generate a high-performance and low-power hardware module. Through the practical experiments, we show that our proposed description method can make HLS generate good hardware module improving the performance and power efficiency compared with the conventional method.
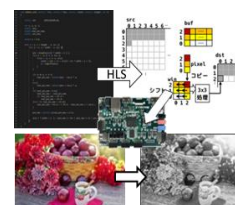
OS15-4 Development of Haze Removing Hardware Using High-Level Synthesis

Daiki Shirai and Akira Yamawaki (Kyushu Institute of Technology, Japan)

We develop a haze removing hardware using high-level synthesis (HLS). Haze removing removes a haze in the picture taken with a camera. It is frequently used as a pre-process for advanced image processing. However, haze removing generally requires a large amount of computational power due to its expensive and complex processing flow in software. Therefore, we decided to develop the haze removing as hardware to save power and improve processing speed at runtime. When developing hardware, we have used HLS converting software to hardware design automatically to flexibly respond to shortened development periods and specification changes. For the software used in high-level synthesis, the algorithm was changed and described so that the performance of the development hardware would be improved. Finally, the developed hardware was able to achieve an 1.43 times performance improvement and a run-time power improvement of about 41.4 times compared to the software execution.
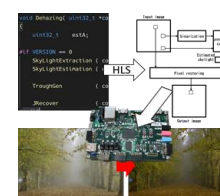
OS15-5 Automatic approximation of primitive shapes using point clouds
Yuma Yoshimoto, Hakaru Tamukoh (Kyushu Institute of Technology, Japan)

This paper proposes a method to estimate appropriate primitive shapes by automatically using a point cloud of objects. The process is as shown in the flow. First, the method estimates a rotation angle of the object. Next, the method places the primitive shape in the center of the object. The primitive shape stretched or compressed to fit the object. The distance between all the points of the object and the primitive shape is measured. The method applies these processes using various primitive shapes. Finally, the most appropriate primitive shape is determined. The experiment confirmed that the method estimates objects like apples and chikuwa to primitive objects, such as spheres and cylinders.
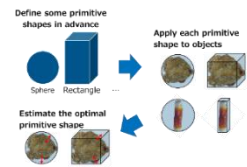
OS16 Robotic Manipulation (4)
Chair Kensuke Harada (Osaka University, Japan)
Co-Chair Tokuo Tsuji (Kanazawa University, Japan)
Co-Chair Akira Nakamura (Saitama Institute of Technology, Japan)

OS16-1 Motion Planning for Retrieving an Object in a Complex Environment
Shusei Nagato, Tomohiro Motoda, Keisuke Koyama, Weiwei Wan, Kensuke Harada (Osaka University, Japan)

This paper proposes a method for retrieving a target object by a robot in a complex environment. In such an environment, it becomes difficult to observe the state of the target object owing to occlusion, and to grasp it. In this work, we propose a method for selecting the viewpoint to observe the occlusion part of the target object by using RGB-D images and selecting the motion from grasping/dragging to retrieve the target object according to the situation. Finally, we confirmed that a robot can retrieve a certain target from the complex environments.

OS16-2 Design and Control of Two-sided Gripper for Bin Picking
He,Maike, Tokuo Tsuji, Tatsuhiro Hiramitsu, Hiroaki Seki (Kanazawa University, Japan)

Bin picking is a core problem in industry automation. The goal is to have a robot with sensors and cameras attached to it pick-up known objects with random poses out of a bin using a gripper. Bin picking technology has the good effect in solving the current shortage of labor. In this research we have completed The designed gripper grasp object from both sides. Proposed an idea of automation, completed the image processing and robot calibration.

OS16-3 Training Data Augmentation for Semantic Segmentation of Food Images Using Deep Learning

Takayuki Yamabe, Tatsuya Ishichi, Tokuo Tsuji, Tatsuhiro Hiramitsu, Hiroaki Seki
(Kanazawa University, Japan)

With the advent of deep learning, the technology for category recognition of meal images has reached a practical stage. However, for more advanced food management, it is desirable to develop a technology that can recognize the distribution of food ingredients. We have focused on semantic segmentation, which is a technique for recognizing the distribution of food ingredients in pixels of an image. In order to achieve highly accurate image recognition, it is necessary for humans to carefully paint the boundaries of food items and assign correct labels, which requires a great deal of effort. In this study, we propose a method to automatically amplify appropriate training data by cropping, flipping/rotating, image composition, and color manipulation based on images of only one type of food.
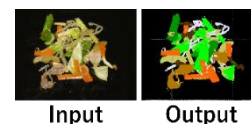
OS16-4 Suitable Error Recovery Process using Combined Evaluation Standards in Robotic Manufacturing Plant

Akira Nakamura[1], Kensuke Harada[2] ([1]Saitama Institute of Technology, [2]Osaka University, Japan)

The number of manufacturing plants where industrial robots work is increasing. Therefore, errors during work are likely to occur. For big errors, it is often necessary to go back to the previous step and resume work. There are two issues: which step to return to and what kind of work to do from the point of return. In this paper, we will show that it is good to use a combination of multiple evaluation standards to decide the planning.
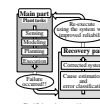
OS17 Advanced Robotics (8)
Chair Evgeni Magid (Kazan Federal University, Russia)
Co-Chair Kuo-Hsien Hsia (National Yunlin University of Science and Technology, Taiwan)

OS17-1 Experience in efficient real office environment modelling in Gazebo: a tutorial

Bulat Abbyasov[1], Kirill Kononov[1], Tatyana Tsoy[1], Martínez-García Edgar A.[2], Evgeni Magid[1]
([1]Kazan Federal University, Russia), ([2]The Autonomous University of Ciudad Juarez, Mexico)

New robotic solutions should be carefully verified before executing with real robots in real environments. Simulation provides a significant support in testing, but requires test sites with a high level of realism. In this case, 3D modeling can be used to produce the necessary 3D digital representation of real objects with varying difficulty. This article presents a step-by-step tutorial on modeling a realistic office environment. The environment contains a building skeleton frame, windows, building tiles, and furniture. Blender modeling toolset was used to create high-quality 3D models in the Gazebo simulator. The constructed virtual environment was validated with a lidar-based SLAM task for a UGV.

OS17-2 Graphical user interface design for a UAV teleoperation

Roman Lavrenov[1], Ramil Safin[1], Bai Yang[2], Martínez-García Edgar A.[3], Roman Meshcheryakov[4]
([1]Kazan Federal University, Russia), ([2]Ritsumeikan University, Japan)
([3]The Autonomous University of Ciudad Juarez, Mexico)
([4]V. A. Trapeznikov Institute of Control Sciences of Russian Academy of Sciences, Russia)

The number of drones being used around the world grows at a high speed. New drones' manufacturers are emerging, new drone designs are being developed. Most drones are controlled by a remote control, while UAV joysticks and communication protocols are different. However, the Robotic Operating System (ROS) allows unifying control process for drones. In this article, we present a universal graphical interface for controlling drones using ROS. The program is written in C++ and Qt and allows to control UAV and receive and visualize data from drones. Due to the use of ROS topics, this program can be applied to any drone with ROS.

OS17-3 Numerical solution approach for the ROBOTIS OP2 humanoid hand inverse kinematics

Zagidullin Linar[1], Tatyana Tsoy[1], Roman Meshcheryakov[2], Kuo-Hsien Hsia[3], Evgeni Magid[1]
([1]Kazan Federal University, Russia)
([2]V. A. Trapeznikov Institute of Control Sciences of Russian Academy of Sciences, Russia)
([3]National Yunlin University of Science and Technology, Taiwan)

Small-size humanoids are widely used in human-robot interaction (HRI) projects and activities. To operate robot limbs in HRI and pick-and-place tasks it is required to solve an inverse kinematics problem. Classical approaches are closed-form solutions with algebraic or geometric approaches or a numerical solution. While a typical numerical solution is supposed to search for joint variables using an iterative optimization, in this paper we suggest an off-line solution for a ROBOTIS OP2 humanoid upper limb via a forward kinematics approach that allows to calculate in advance all possible solutions for an end effector pose within a robot workspace with several levels of the workspace discretization. The solution was obtained in a simulation and successfully validated with a real ROBOTIS OP2 humanoid.

OS17-4 Alvus modelling in Gazebo

Liaisan Safarova[1], Bulat Abbyasov[1], Tatyana Tsoy[1], Hongbing Li[2], Evgeni Magid[1]
([1]Kazan Federal University, Russia), ([2]Shanghai Jiao Tong University, China)

Insufficient testing of medical robots can lead to accidents during a surgery and damage an expensive equipment. A simulated 3D patient permits a preliminary checking of robotics-based medical scenarios without threatening a real patient's health. This article presents a 3D model of a human abdomen, which contains vital organs: intestine, liver, stomach, and kidneys. There are 3 layers of an abdominal wall: skin, adipose, and muscle. Several types of pathologies were modeled: cysts, tumors, and gallstones. Blender modeling software was used to create realistic 3D models of organs with their distinctive features for Gazebo simulator. The model is presented as a ROS package with necessary configuration files and can be used by other researchers to simulate medical operations in Gazebo environment.

OS17-5 Testing procedures architecture for establishing a fiducial marker recognition quality in UAV-based visual marker tracking task in Gazebo simulator

Mikhail Kilin[1], Roman Lavrenov[1], Bai Yang[2], Mikhail Svinin[2], Evgeni Magid[1]
([1]Kazan Federal University, Russia), ([2]Ritsumeikan University, Japan)

Fiducial markers could be used in different tasks, including UAV and UGV marker-based localization. In most cases developers do not consider features of fiducial markers' systems (FMS) while selecting a particular FMS for a project. However, this selection might significantly influence results of experiments and thus the quality of a resulting product, an algorithm or a software. In this work, we define an architecture of experimental framework that allows finding an optimal marker for a UAV in a mobile ground object following task. The proposed framework estimates an average deviation of a detected Aruco marker position and an accuracy of the UAV landing on the marker. The framework uses Robot Operating System and employs UAV PX4 LIRS model in the Gazebo simulator.

OS17-6 Feature importance evaluation method for multi-agent deep reinforcement learning in advanced robotics task allocation

Sergey Ryabtsev[1], Mikhail Gurchinsky[1], Igor Struchkov[1], Vyacheslav Petrenko[1], Fariza Tebueva[1], Sergey Makarenko[2]
([1]North-Caucasus Federal University, Russia),
([2]Saint Petersburg Federal Research Center of the Russian Academy of Sciences, Russia)

The need to tackle intelligent tasks using advanced robotics multi-agent systems (MAS) actualize the use of artificial neural networks (ANNs) and multi-agent deep reinforcement learning technology. The article aims to solve the problem of exponential growth of ANN complexity with an increase in the number of agents in the MAS. To solve this problem, we propose an evaluation method for input data features importance. This method allows to optimize the input data feature set to reduce the computational complexity of the ANN inference while providing the same level of performance.
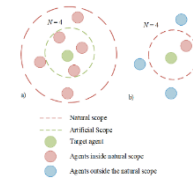
## OS17-7 Iterative method of labor division for multi-robotic systems

Sergey Ryabtsev[1], Artur Sakolchik[2], Vladimir Antonov[1], Vyacheslav Petrenko[1], Fariza Tebueva[1], Sergey Makarenko[3]
([1]North-Caucasus Federal University, Russia),
([2]Belarusian State University, Belarus)
([3]Saint Petersburg Federal Research Center of the Russian Academy of Sciences, Russia)

Labor division in multi-robotic systems allows to distribute tasks between agents in order to increase the efficiency of performing the global task. Collective decision-making methods allow agents to form the "agent-task" pairs. In this paper, we consider the case when the number of tasks significantly exceeds the number of agents. We propose an iterative method of labor division in multi-robotic systems. It uses collective decision-making to assign a cluster of subtasks to an agent. The paper examines different ratios between cluster size, number of clusters, and number of agents in order to find ratios that provide minimal average global task execution time and minimal average energy consumption.
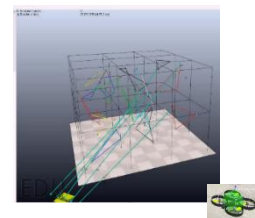
OS17-8 Development of Bowling Machine Using VEX IQ

Kuo-Hsien Hsia[1], Ya-Chun Chen[1], Evgeni Magid[2], Xin-Ying Zeng[1]

([1]National Yunlin University of Science and Technology, Taiwan)

([2]Federal Kazan University, Russia)

VEX IQ is a kind of educational robotics platform focuses on semi-automatic and semi-remote. In this paper, a fully automatic bowling machine based on VEX IQ educational robotics platform has been developed. Since the brain of VEX IQ cannot communicate to other VEX IQ brains and the components of VEX IQ are made of plastic, it is necessary to overcome these problems to create mechanism similar to steel-made constructions and form an intelligent large system. We use sensors as communication interface for the brains of VEX IQ. Totally 3 brains and 10291 VEX IQ plastic components are used for the construction of the bowling machine. The overall size is about 252x93x90 in centimeters.

OS18 Natural Computing (3)

Chair Marion Oswald (Technische Universität Wien, Austria)

Co-Chair Yasuhiro Suzuki (Nagoya University, Japan)

OS18-1 An Acoustic Artificial Life System Using the Game of Life and its Application for Performing Arts

Yasuhiro Suzuki (Nagoya University., Japan)

Sound and vibration are forms of energy propagation. We have constructed an artificial life form that takes sound as energy and produces energy. The system converts sound into a two-dimensional pattern and uses it as input to the Game of Life. After n steps, the Game of Life is re-transformed into sound, and the sound is output. The sound allows the artificial life in the PC to interact with the outside world. We used this system to create an artwork that interacts with a dancer interactively through sound.

OS18-2 The Effect of Non-audible Low Frequency, Deep Micro Vibrotactile, DMV Sounds on Music

Yasuhiro Suzuki (Nagoya University, Japan)

The 1/f fluctuation is a fluctuation in which the power spectrum is inversely proportional to the frequency f. 1/f is found in natural and manufactured phenomena and is widespread in music. Although sounds below 20Hz are inaudible to humans, the lowest notes of a pipe organ are 8Hz or 16Hz, and orchestral music contains inaudible low-frequency sounds. We have shown that a not 1/f can fluctuate at 1/f by adding shallow frequency sounds.
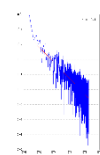
OS18-3 Response of Yeast to Low Frequency Sound Exposure
Yasuhiro Suzuki (Nagoya University, Japan)

The primordial Earth, where life began, has been exposed to solid infrasound due to active mountain building and intense weather. Yeast, Saccharomyces cerevisiae, was the first eukaryotic organism to emerge 2.1 billion years ago. We investigated the response of yeast to low-frequency sound. It has known that the yeast is cultured by shaking a culture flask, the intensity of shaking changes the growth rate. We have confirmed that the power of the low-frequency exposed sound may affect the growth rate.
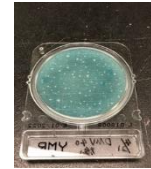
OS19 Industrial Artificial Intelligence Robotics (7)
Chair Eiji Hayashi (Kyushu Institute of Technology, Japan)
Co-Chair Sakmongkon Chumkamon (Kyushu Institute of Technology, Japan)

OS19-1 Online Deep Reinforcement Learning on Assigned Weight Spaghetti Grasping in One time using Soft Actor-Critic
Prem Gamolped, Sakmongkon Chumkamon, Tomofumi Tsuji, Nattapat Kloomklang, Chanapol Piyavichayanon, Ranatchai Laosiripong, Eiji Hayashi (Kyushu Institute of Technology, Japan)

With the growth of the food industry recently, especially in pandemics, Artificial Intelligence and robotics have become essential and widely used to package food. Human error in food production can cause accuracy and performance issues since the food is soft, non-rigid, and nonpattern, mainly noodle-like. This paper proposes a challenging novel self-learning robotics grasping for spaghetti using deep reinforcement learning (DRL) based on the soft actor-critic. The manipulator is trained for one-shot grasping spaghetti where the robot could get the state from the RBGD camera. We also implement spaghetti detection and segmentation for the input state of the DRL. Finally, we present the evaluation and discussion of the spaghetti grasping.

OS19-2 The research about editing system of performance information for player piano. - Inference in the same phrase including ostinato-
Haruna Yamasaki, Sakmongkon Chumkamon, Eiji Hayashi (Kyushu Institute of Technology, Japan)

Playing the piano expressive by player piano, it is necessary to adjust the volume, length, and timing of music. In the case of piano music, there are often 1000 or more notes in the score of even a short piece of music. So, to edit music data manually requires not only knowledge but also a huge amount of time and effort. Therefore, we aimed to develop a system that, like a skilled pianist, can perform even the first musical score based on information related to previous skills and experience. So, we developed a system that automatically estimates the performance expression of unedited music using edited performance data and score data. In this paper, I studied the changes in performance expression when similar phrases such as ostinato are repeated in a piece by F. Chopin, and described a new method of inference.
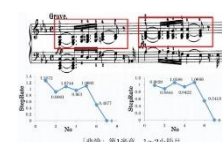
OS19-3 Weight estimation for noodle products in food layout of a home replacement meal

Tomofumi Tsuji[1], Sakmongkon Chumkamon[1], Chanapol Piyavichayanon[1], Prem Gamolped[1], Ranatchai Laosiripong[1], Ayumu Tominaga[2], Ryusuke Fujisawa[1], Eiji Hayashi[1]
([1]Kyushu Institute of Technology, Japan)
([2] National Institute of Technology, Kitakyushu College, Japan)

In recent years, there has been an increasing demand for robot automation to improve productivity in the food layout of lunchboxes and prepared foods in the Japanese home replacement meal industry. In this research, we are developing autonomous work robots that can perform midday meal serving tasks and developing the technology for industrial food automation using Artificial Intelligence (AI) to improve productivity, security, and safety. In this paper, we perform weight estimation of the served object to identify the amount of spaghetti grasped. We created our dataset of spaghetti used for weight estimation. The spaghetti is in different types of containers, the various weight of spaghetti, and the random position of spaghetti in the robot workspace. We also propose a deep learning method using RGB-D cameras for weight estimation and describe its validation and evaluation.
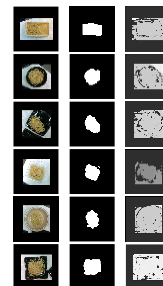
OS19-4 Cognition of surrounding conditions for a field robot Slope detection using a multilayer perceptron classifier with point cloud as input -

Takumi Tomokawa[1], Sakmongkon Chumkamon[1], Ayumu Tominaga[2], Sylvain Geiser[1], Ryusuke Fujisawa[1], Eiji Hayashi[1]
([1]Kyushu Institute of Technology, Japan), ([2]National Institute of Technology, Kitakyushu College, Japan)

In the Japanese forestry industry, automation of work to supplement labor is desired to achieve sustainable forest management. In this study, the field robot for the automation of forestry is developed. In the field robot, recognition of the surrounding situation is an important function for safe movement. In this paper, we focus on the recognition of terrain. The terrain in a mountainous area has various conditions such as slope, presence of weeds and trees, and unevenness. In this study, the classifier for ground and sloped surfaces using Multi Layered Perceptron (MLP) is developed. This classifier classifies each point of the 3D point cloud acquired from the RGB-D camera into the ground plane of the robot and the slope plane where the robot cannot climb. The accuracy of the classification was verified by training the classifier on a dataset acquired in a real environment.
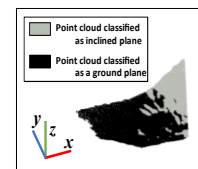
OS19-5 Particle Filter Based SLAM For Forestry Robot

Sylvain Geiser[1], Sakmongkon Chumkamon[1], Ayumu Tominaga[2], Takumi Tomokawa[1], Eiji Hayashi[1]
([1]Kyushu Institute of Technology, Japan)
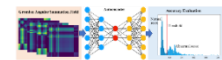([2] National Institute of Technology, Kitakyushu College, Japan)

In Japan, the forestry workforce is dramatically declining. Therefore, field robots are investigated to replace humans for dangerous actions. Task execution with such mobile robots requires localization and mapping. This research focuses on online SLAM implemented on SOMA forestry robot developed at Hayashi Laboratory. In this approach, the core algorithm is a Rao-Blackwellized particle filter, and the environment is represented by a map of features which are trees. Furthermore, motion is captured by odometry through rotary encoders and observation is described by a range-bearing model. The raw pointcloud of the mounted lidar is processed in order to get distance and azimuth for each detected landmark. A realistic simulation has been build using Gazebo and the results of first experiments speak for real-time capability.

OS19-6 Anomaly Detection using Autoencoder with Gramian Angular Summation Field in Time Series Data

Umaporn Yokkampon[1], Sakmongkon Chumkamon[1], Abbe Mowshowitz[2], Eiji Hayashi[1]
([1]Kyushu Institute of Technology, Japan), ([2]The City College of New York, USA)

Uncertainty is ubiquitous in data and also represents a real-life challenge. To deal with this challenge, we propose a novel method for detecting anomalies in time series data based on the Autoencoder method, encoding the time series as images by means of Gramian Angular Summation Field (GASF). Time series data is represented as 2D image data to enhance anomaly detection. The proposed method is validated with four time-series data sets. Experimental results show that our proposed method can improve validity and accuracy on all criteria. Therefore, analysis of time series data by combining Autoencoder and Gramian Angular Summation Field methods can effectively detect anomalies.

OS19-7 Autonomous Robot Packaging Ready Meal in Conveyor Production Line

Sakmongkon Chumkamon, Tomofumi Tsuji, Prem Gamolped, Chanapol Piyavichayanon, Umaporn Yokkampon, Eiji Hayashi (Kyushu Institute of Technology)

Food automation technology becomes increasingly important in industrial and scientific research especially in a social distance of pandemics. In this paper, we investigate the robotic motion planning and grasping for the food, which is nonrigid, nonpattern, and soft since the food is difficult to grasp. Moreover, in automation, the process has to be organized on time since the automation uses the conveyor production line. This paper contributes three points. The first is motion planning online while the production line conveyor operating. The second is real-time Non-Pattern Food Segmentation. The third is grasping non-rigid, nonpattern and soft objects of food. Additionally, the robotics grasping also proposes the finishing decorating spaghetti packaging by rolling the spaghetti while the conveyor moving which is our novel proposed.
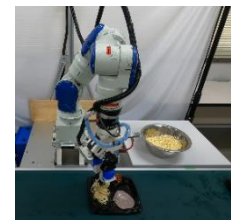
## OS20 Application studies on sensor and RFID system (6)
Chair Takao Ito (Hiroshima university, Japan)
Co-Chair Ammar A.M. Al-Talib (UCSI University, Malaysia)

OS20-1 A Pedal Powered Water Purifier

Ammar A.M. Al-Talib, Ting Kee Yuan, Sarah 'Atifah Saruchi (UCSI University, Malaysia)

Water is a necessity for every living organism on Earth. However, in certain parts of the world especially in rural areas, clean drinking water is a luxury to the residents. This is because they are not supplied with clean water and thus must source for water from rivers, rainwater, and wells which are often contaminated and unsafe for drinking. The objective of this study is to design and fabricate a functional prototype of a pedal powered water purifier, and to ensure that purified water is safe for consumption based on chemical water analysis. The quality of the purified water will be compared to the Drinking Water Guidelines provided by the World Health Organization (WHO). The system utilizes the distillation method to produce clean drinking water. The charging efficiency of the generator has reached 48.74% at 60rpm cadence. Based on the chemical analysis of purified water, it has been proven that it meets the standards set by WHO and is safe for consumption.
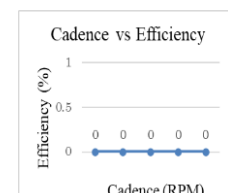
OS20-2 A Smart Node (Maintenance & Lifespan Prediction System)

Kam Heng Chaw[1], Ammar A.M. Al-Talib[2], Tarek Fawzi[2], Jonathan Yong Chung Ee[2]
([1]MODU System (S) Pte Ltd, Malaysia), ([2]UCSI University, Malaysia)

Since the present business environment is suffering uncertainty due to the economic fluctuations, not only the failure anticipation of production lines is fundamental, but also it is critical to preserve company's capital and production flowing. Failure doesn't occur overnight, as the warning signal from many different sources emerge, and even the production quality/quantity evolve prior to the failure. Hence, surveillance of these signals 'sources could be used as an input for a system that depends on smart factory principles to predict failure and parts' lifespan in advance. This idea was echoing for few years but now it became achievable due to the development of the artificial intelligence (AI), machine learning, data mining and data reservoir technologies. The project aimed to develop novel maintenance mechanism based on industry 4.0 principles, implementing of the IoT monitoring system on manufacturing line and verifying and validating the performance of the maintenance system.

OS20-3 A Healthcare Laundry Management System using RFID System

Eryana Hussin, Wong Jie Jian (UCSI University, Malaysia)

The paper presented the use of Ultra-High Frequency (UHF) Radio Frequency Identification System (RFID) for laundry management system in healthcare. The laundry management system consists of the waterproof RFID laundry tags, RFID reader and the data recording system which was build using Visual Basic and Microsoft Access software. In this project, the users will be able to monitor the process of the hospital's linen which includes the pillowcases, bedsheets, towels, and other hospital linens. The advantage of using this laundry management can reduce the human error of missed count the items, and to ensure smooth laundry item cleaning process to be executed. Moreover, the user will be able to monitor the status of certain linen items. The database recoding system presented in this paper can reduce the human error, effective and systematic compared to the traditional laundry counting and recording system. This laundry management system also can be used for hotels laundry management for the linen that can be tagged to prevent the loss of items such as towels, blanket, and curtains.
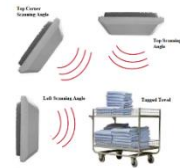
OS20-4 A Monitoring System with Humidity and Growth Level Detection for Horticulture

Eryana Hussin, Ng Joon Wen (UCSI University, Malaysia)

Smart Farming System with humidity and growth level detection presented in this paper is designed to monitor and control the production of the fresh produce. This smart farming system is designed to monitor the changes due to environment parameters which includes temperature, soil moisture level of the crops, and growth level of the crops. A sensor is placed at certain distance from the plant and the growth rate of the plant is monitored from time to time. In this prototype, the 12V fan is connected to the relay and will be turn on when the temperature drops below the minimum accepted range for the produce. The Smart Farming System proposed in this paper is built with a combination management system including environment parameters monitoring system and automatic technology control system. Arduino UNO is the central unit that plays an important role to receive and control all the function of the project. This combined system is design for modern smart horticultural or large-scale horticultural to produce more sustainable production.

OS20-5 A Double Identification Attendance System Using High Frequency RFID System
Eryana Hussin, Wong Chee Ming (UCSI University, Malaysia)

In this paper, the double identification attendance system integrated with High Frequency Radio Frequency Identification (RFID) and sensors is presented. This double identification system requires users to be detected by two different mechanisms. This double identification system is proposed to overcome the problem of false attendance by the students who just stopped by to tag their student identification card without attending the class. The attendance system presented in this paper can capture the time in and time out of each student which will be automatically captured if the students successfully pass through both RFID reader and motion sensor. The proposed attendance system is designed to replace the manual attendance system which still implemented in this modern era. The unique features of the RFID system which able to capture and store the student attendance in the database system effectively and can reduce the time for the teachers to take the attendance daily. This double identification attendance system also will be useful for any event or training provider to record the attendance of the attendant effectively.
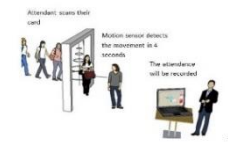
OS20-6 Levitating Frictionless-Vertical Windmill-
Ammar A.M. Al-Talib, Muhammad R. Md. Redzuan (UCSI University, Malaysia)

To harness wind energy in low wind speed areas, a vertical axis wind turbine (VAWT) is generally more suitable than a horizontal axis wind turbine. To improve the feasibility of using a VAWT, a magnetic levitation bearing concept, utilizing neodymium magnets, is used to make the bearing frictionless. A new experimental type of airfoil called EN0005 is used that boasts better self-starting ability than conventional airfoils. The design parameters of the wind turbine are explored and reviewed to create a final design that is modelled in SolidWorks. This final design is then put through simulations and analysis in ANSYS FLUENT before being fabricated as a prototype. This final prototype produces similar results to other findings and validates the report. The EN0005 blade profile appears to improve the self-starting capability of the wind turbine and improve viability of Darrieus turbines in lower wind speeds. These findings verify the benefits of using a magnetic frictionless bearings for wind turbines.
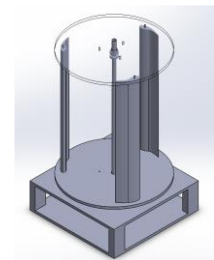
OS21 Visual Signal Processing and Human-welfare Robotics I&II (7)
Chair Joo Kooi Tan (Kyushu Institute of Technology, Japan)
Co-Chair Nobuo Sakai (Kyushu Institute of Technology, Japan)

OS21-1 Object Acquisition Based on Human-Robot Cooperation
Kota Ito, Masuhiro Nitta, Seiji Ishikawa, Joo Kooi Tan (Kyushu Institute of Technology, Japan)

In recent years, the population of elderly persons who are unable to go for shopping to buy their daily necessities is increasing. Putting an intelligent shopping robot as a future goal, in this paper, we propose a human-robot cooperative system in which a developed robot goes to a spot where a user specifies, acquires goods which the user wants and brings the goods back to the user. To realize this, real-time user-robot communication, processing of the two kinds of images provided from an RGB-D camera, and robot manipulation and travel control are done. The effectiveness of the proposed method was verified by experiments. The proposed robot system will provide a support system for shopping refugee, such as an elderly, a bedridden or a physically-disadvantage person, in future based on online real-time goods selection.

OS21-2 Development of Musculoskeletal Walking Simulator for Analysis of Human Walking and Rehabilitation
Nobuo Sakai, Yukiho Ryu, Tsubasa Ikeda, Mochimitsu Komori (Kyushu Institute of Technology), Masako Fuchi (Kyushu Nutrition Welfare University), Katsuki Hayashi (Seiai Rehabilitation Hospital)

In the field of rehabilitation, the explanation of walking motion, called 'Rocker function', is one of the practical indexes for the facilitation of human walking in clinical settings. If this explanation is true, we can reconstruct it by artificial materials. In this study, we tried to develop the musculoskeletal walking simulator, which can actually reproduce bipedal walking according to the Rocker function. Muscles and tendons including biarticular arrangements were represented by springs and cables. In this report, 3 muscles were actuated by servomotor. The simulator reproduced the human musculoskeletal walking motion generated from its intellectual structure in nature. The results would support the insight of the explanation of Rocker function in the rehabilitative treatments.
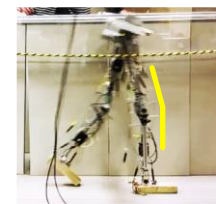
OS21-3 Collision Avoidance in a Human-Robot Coexistence Food Preparation Environment Using Hands Area Extraction
Takaaki Yotsumoto, Yuta Ono, Masuhiro Nitta, Joo Kooi Tan (Kyushu Institute of Technology, Japan)

In Japan, the population of the working-age between 15 and 64 years old has been declining. In order to solve the labor shortage, the introduction of industrial robots that can perform tasks equivalent to humans especially in a food preparation industry is strongly requested. In a human-robot cooperative environment, it is indispensable to avoid collision between workers and robot. In this paper, we propose a method of automatic hand area extraction of a robot and a worker in a food preparation work line based on an ego-camera and the use of color distribution and GrabCut. on the images provided from the camera. A warning is issued, if the hands of the side workers/robots approach close to the central work area. Experimental results show satisfactory results. The method is under refinement so that it will adapt to various hand colors and illumination change.

OS21-4 Supporting Safe Walk at a Railway Station Platform for a Visually Impaired Person Based on MY VISION

Yuki Kawaguchi, Seiji Ishikawa, Takashi Shinomiya*, Joo Kooi Tan

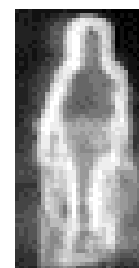(Kyushu Institute of Technology, Japan, *N&N Inc.)

The platforms of a railway station is a dangerous place for visually impaired person. However, not all stations, except those in large cities, are equipped with platform doors. Therefore, a supporting system is requested for safe walk of a visually impaired at a station platform. In this paper, we propose a system that prevent a visually impaired person from falling on the track from the edge of a platform using MY VISION. The proposed system employs a depth image captured by MY VISION. It uses Line Segment Detector and Graph-Based Image Segmentation to detect the edge of the station platform. If the users of MY VISION approach the edge too close, the system gives a warning to the user. The effectiveness of the proposed method was verified by experiments.
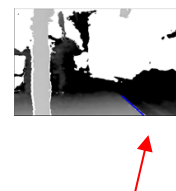
OS21-5 Detecting a Pedestrian's Walk Direction Using MY VISION for Supporting Safe Walk of a Visually Impaired Person

Shinya Iizumi, Yuta Ono, Masuhiro Nitta, Seiji Ishikawa, Joo Kooi Tan

(Kyushu Institute of Technology, Japan)

As a means of assisting a visually impaired person to walk safely, a system has been proposed that recognizes surrounding pedestrians and their approaching directions using the images obtained by MY VISION. However, since the conventional method used a pedestrian's model to generate MSC-HOG (Multiple-Scale-Cell Histograms of Oriented Gradients) features, it is specialized only for recognizing pedestrians. Thus it is difficult to recognize other passers-by such as cyclists. To solve this problem, we propose a method to recognize not only pedestrians, but also cyclists using the average edge images of pedestrians and cyclists based on MSC-HOG. We also use different discriminators for robustly detecting passers-by who approach a MY VISION user. The effectiveness of the proposed method was verified by experiments.

OS21-6 Fruits and Vegetables detection using the improved YOLOv3

Changhua Xu, Ziyue Liu, Masuhiro Nitta, Joo Kooi Tan (Kyushu Institute of Technology, Japan)

As the global aging intensifies, it is more convenient for a robot go for shopping to buy things like vegetables or fruits instead of elderly persons themselves. It is then important that a robot is more human-like to select items according to a user's personal preferences such as maturity of fruits, sweetness, freshness and so on. However, fruits or vegetables are generally displayed in a disorderly manner. Therefore, thorough detection and recognition of fruits and vegetables is a difficult task for a robot. This paper proposes an improved YOLOv3 and also pre-training the networks to detect fruits and vegetables and to recognize their maturity. The effectiveness of the proposed method is shown by experiments.

OS21-7 Strict frequency estimation of sinusoidal signal using sampling function(withdraw)
Masuhiro Nitta (Kyushu Institute of Technology, Japan)

This paper considers an accurate frequency estimation problem of a sinusoidal signal acquired by an analog-to-digital converter. By making use of an A/D converter, pure sinusoidal signal is digitized and quantized error occurs. Thus the estimated frequency slightly differs from the original one. The aim of this study is to identify the original frequency based on the theory of distributions. As the continuous test function with compact support, the paper utilizes a sampling function. Although the proposed estimation method requires the derivative of the sinusoidal signal, sampled sinusoidal signal becomes a nondifferentiable function. The distributions overcome this difficulty by using integration by parts of the sinusoidal signal and the sampling function. The effectiveness of the proposed method is demonstrated by some numerical simulations.
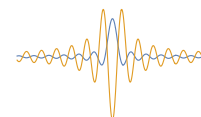
## OS22 Advanced studies of network engineering (4)
Chair Wei Hong Lim (UCSI University, Malaysia)
Co-Chair Takao Ito (Hiroshima University, Japan)

OS22-1 New Hybridization Algorithm of Differential Evolution and Particle Swarm Optimization for Efficient Feature Selection
Koon Meng Ang, Mohd Rizon Bin Mohamed Juhari, Wei Hong Lim, Sew Sun Tiang, Chun Kit Ang, Eryana Eiyda Hussin, Li Pan, Ting Hui Chong (UCSI University, Malaysia)

Feature selection is a popular pre-processing technique applied to enhance the learning performances of machine learning models by removing irrelevant features without compromising their accuracies. The rapid growth of input features in big data era has increased the complexities of feature selection problems tremendously. Given their excellent global search ability, differential evolution (DE) and particle swarm optimization (PSO) are considered as the promising techniques used to solve feature selection problems. In this paper, a new hybrid algorithm is proposed to solve feature selection problems more effectively by leveraging the strengths of both DE and PSO. The proposed feature selection algorithm is reported to achieve an average accuracy of 90.54% when solving 13 datasets obtained from UCI Machine Learning Repository.
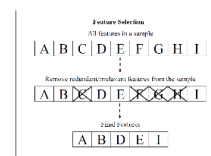
OS22-2 Implementation of LoRa in River Water Quality Monitoring

Syarifah Nabilah Syed Taha Tahir, Mohamad Sofian Abu Talip, Mahazani Mohamad, Mohamadariff Othman, Tengku Faiz Tengku Mohmed Noor Izam, Mohd Faiz Mohd Salleh, Zati Hakim Azizul Hasan, Zeeda Fatimah Mohamad, Amir Feisal Merican Aljunid Merican (Universiti Malaya, Malaysia)

Emergence of Long Range (LoRa) in network technologies become game changer for Internet of Things (IoT) application. Deployment of LoRa enable IoT application of environment monitoring to cover wide area while maintain at low energy and low cost. Water quality monitoring program was developed to maintain and protect quality of water resources for daily purpose. Also, to prevent pollution and disease epidemic peculiarly during Covid19. This research aimed to build autonomous water quality monitoring prototype implemented with LoRa network for support decision system. The Wireless Sensor Nodes (WSN) that embedded with five type of water quality sensors of pH, turbidity, total dissolved solid (TDS), dissolved oxygen (DO) and temperature linked to single gateway. Water environmentalist able to view the result of timely water quality from mobile application dashboard. Though the performance not severely affected, acquired results revealed non-line of sight condition, transmission power and Spread Factor (SF) value influenced LoRa performance in urban environment. In conclusion, a few improvements on the system grant LoRa high capabilities to be integrated with IoT environment application in urban environment.
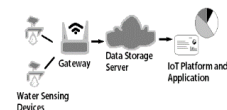
OS22-3 Wideband Antenna with UHF Sensor Applicability for MV/HV Equipment in Smart-Grid Systems

S. M. Kayser Azam[1], Mohamadariff Bin Othman[1], Tarik Abdul Latef[1], H. A. Illias[1], Mohd Fadzil Ain[2], Yazeed Qasaymeh[3] ([1]Universiti Malaya, Malaysia) ([2]Universiti Sains Malaysia, Malaysia)
([3]Majmaah University, Saudi Arabia)

Abstract—In this paper, a wideband antenna is proposed to be used as an ultra-high frequency (UHF) sensor for medium to high voltage equipment for the next generation smart-grid systems. The antenna is designed on a heat-protected substrate so that it can withstand the extreme environment of a power substation. The proposed antenna operates within the UHF range with wideband characteristics. The peak and average values of the realized gain indicate that the antenna has the ability to largely improve the received signal before delivering it for data analysis and processing. The antenna radiates with an omni-directional pattern in the three-dimensional view. Efficiency of the proposed antenna is quite decent, and the physical dimension of the antenna is compact enough to be used as an UHF sensor. The proposed wideband antenna as an UHF sensor is designed to be aimed especially at the faulty-insulation detection in medium to high voltage equipment like power cables, power transformers, gas-insulated switchgears etc. while adopting the smart-grid technology.

$$W_m = \frac{7.48 \times h}{\Upsilon^{(\frac{\Upsilon_0 + 1.41}{87})}} - 1.25 \times \Upsilon$$

W_m = feedline width
L_m = feedline length
Υ_0 = characteristic impedance
Υ_m = relative dielectric permitivity
h = substrate height
Υ = conductive trace thickness

OS22-4 New Particle Swarm Optimization Variant with Modified Neighborhood Structure

Koon Meng Ang[1], Mohd Rizon Bin Mohamed Juhari[1], Wy-Liang Cheng[1], Wei Hong Lim[1*], Sew Sun Tiang[1],
Chin Hong Wong[2], Hameedur Rahman[3], Li Pan[1]
([1]UCSI University, Malaysia) ([2]Fuzhou University, China) ([3]Air University, Islamabad, Pakistan)

Numerous particle swarm optimization (PSO) variants were proposed in past decades to tackle different types optimization problems more robustly. Nevertheless, the imbalance of explorative and exploitative search behaviors remains as an on-going research challenge that can restrict the performance of PSO. In this paper, a new variant known as PSO with time-varying topology connectivity (PSO-TVTC) is proposed. A time-varying topology connectivity (TVTC) module is designed to achieve the proper regulation on explorative and exploitive behaviors of PSO via dynamic modification of particle's topology connectivity throughout the optimization process. Experimental results reveal that the proposed PSO-TVTC has exhibited prominent performance among its competitors by producing 7 best mean fitness out of 8 benchmark functions.
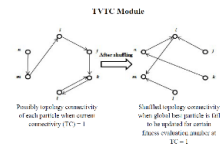

OS23 Applications in Complex Systems (7)
Chair Masao Kubo (National Defense Academy, Japan)
Co-Chair Hiroshi Sato (National Defense Academy, Japan)

OS23-1 A research of infectivity rate After the Consecutive Holidays

Saori Iwanaga (Japan Coast Guard Academy, Japan)

I found there are super-spreaders in the Japan Coast Guard Academy case, but super-spreading depends on the timing of bringing in. After three consecutive holidays from January 7 to January 9, 2017, students returned dormitory in JCGA and started to take classes. Then, 25 % of students were infected in two weeks. We had introduced a refinement to the SEIR model to previously infectious "P" state in the incubation period and proposed a discrete mathematical SEPIR model for influenza. By examining infection from the students of previously infectious "P" state, I found that there are super-spreaders who directly infected over 10 students in this case. But, super-spreading doesn't depend on the features of a person, it depends on the timing of bringing in. I found that students can super-spread seasonal influenza until the first infected students are found. After that, because most students take measures of seasonal influenza, the number of patients decreases.
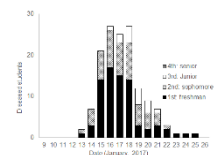
OS23-2 Towards the Trusted Population-Based Optimization Systems

Hiroshi Sato, Masao Kubo (National Defense Academy, Japan),

Following the development of evolutionary computation, various population-based optimization methods have been proposed. In these systems, optimization is achieved through the interactions of many individuals/particles/agents. However, when the system is implemented in a distributed environment, reliability becomes an issue. In such an environment, it may not be possible to trust others. There are numerous cases why we cannot guarantee trust, such as malfunction of distributed parts or failure to synchronize. Therefore, we have to make trust between distributed individuals/particles/agents. The record of past actions is usually a good tool for generating trust. This paper introduces the blockchain mechanism into the population-based optimization system to make a trust management system. By using blockchain, we can implement it without a central authority. In the system, all interactions are reviewed and get feedback, and the feedback is used to calculate the trust score. We consider several scoring methods for this type of system.
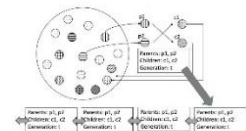
OS23-3 Spatio-temporal prediction of crime occurrence spots by CNN-LSTM

Kaede Yaji, Masao Kubo, Hiroshi Sato (National Defense Academy, Japan)

This paper proposes a method for spatiotemporal prediction of crime occurrence locations based on previous data. In recent years, Japanese government has begun to release data on crime occurrences to improve the efficiency of policing. In addition, the development of maps that can manage patrol and assist residents' crime prevention has been planned. For statistical crime prediction, while several methods are invented abroad, it has just begun to develop a specific crime prediction model for a low-crime country, Japan. One of the known methods uses LSTM to predict crime occurrences only from a temporal perspective, but it cannot predict points of crime occurrences and is insufficient to generate a map. Therefore, we propose a method that combines this LSTM based method with CNN that can adopt geographic locations. As a result of computer experiments, this method seems to be able to make predictions with a tendency to capture actual characteristics.

OS23-4 Cross-View Image Geo-Localization using Multi-Scale Generalized Pooling with Attention Mechanism

Duc Viet Bui, Masao Kubo, Hiroshi Sato (National Defense Academy, Japan)

Cross-view image matching for geo-localization is the task of finding images containing the same geographic target across different platforms. This task has drawn significant attention due to its vast applications in UAV's self-localization and navigation. Given a query image from UAV-view, a matching model can find the same geo-referenced satellite image from the database, which can be used later to precisely locate the UAV's current position. Many studies have achieved high accuracy on existing datasets, but they can be further improved by combining different feature processing methods. Inspired by previous studies, in this paper, we proposed a new strategy by using a channel-based attention mechanism with a generalized mean pooling method to enhance the feature extracting process, which improved accuracy.

OS23-5 Recommendation a Emergency Patient Destinations by LightGBM

Ryota Kawaguchi, Masao Kubo, Hiroshi Sato (National Defense Academy, Japan)

In this study, we aim to reduce the burden of selecting a destination hospital for a rescue team. We propose to adopt the LightGBM method to recommend a destination hospital based on information such as a conversation between the patient and a call center. Previous studies have used detailed information such as patients' disease histories, whereas we use only simple information. Therefore, it can be implemented in regional medical organizations that do not have enough medical information systems. For our method, we used Doc2vec to convert the text of the conversation to a vector. As a result, the LightGBM method has an accuracy score of 70%. It is higher than the k-nearest neighbor, logistic regression, and neural network. In addition, by analyzing the result of our method, we found that age, injury or illness level, and location information are important factors for improving accuracy scores.

OS23-6 A Framework for Understanding the Neural Underpinnings of Symbolic and Non-Symbolic Communication Based on Global Synchronization in Human Brain Activity

Masayuki Fujiwara, Takashi Hashimoto (Japan Advanced Institute of Science and Technology, Japan)

We propose a framework for understanding the neural underpinning of communication with electroencephalogram (EEG) synchronization. It consists of four stages: 1) two-dimensional space defined by symbolic/embodied (non-symbolic) vs. voluntary/involuntary to characterize the target communication, 2) ontological hierarchy to focus the level of synchronization analysis, 3) neurocognitive modeling to hypothesize neural mechanism, and 4) model-based EEG neurofeedback to empirically validate the hypothesis. We claim that following the framework makes it possible to advance our understanding of neural dynamics and mechanisms for communication. Moreover, we analyzed two EEG experiments, implementing the former two stages: the formation of symbolic communication changing from voluntary to involuntary and embodied communication competing between voluntary and involuntary. Their outcome is a hypothesis that three different brain regions are involved in interpreting symbols, motor intentions, and social coordination. A neural field model and a manipulation technique with EEG-based connectivity neurofeedback are also proposed for the latter stages.
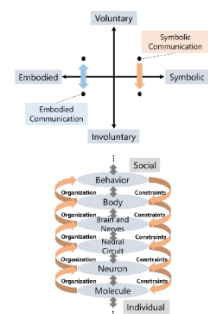
OS23-7 Characterization of randomness tests by using tests results of weakly correlated chaotic sequences

Akihiro Yamaguchi (Fukuoka Institute of Technology), Asaki Saito (Future University Hakodate, Japan)

High quality pseudo-random number sequences are required in various fields of engineering, and the statistical test of randomness is one of the important subjects. A typical test suite of randomness, e.g., DIEHARD, NIST SP800-22, and TestU01, is defined as a set of several different kinds of random number tests. One problem here is that the similarity between the individual tests included in the test suite is not obvious, and it is difficult to make an argument for the optimality of a set of randomness tests. In this study, we propose a characterization method based on the test results of weakly correlated binary sequences generated by the piecewise linear chaotic map. Then, we characterize randomness tests included in the test suite of NIST SP800-22 and discuss the characterization performance of our proposed method.
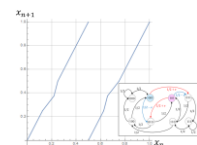
OS24 Artificial Systems and Life (5)
Chair Kuo-Hsien Hsia (National Yunlin-University of Science and Technology, Taiwan)
Co-Chair Chung-Wen Hung (National Yunlin-University of Science and Technology, Taiwan)

OS24-1 An EtherCAT Based Delta Robot Synchronous Control Application
Chung-Wen Hung[1], Yu-Hsuan Tseng[1], Chau-Chung Song[2], Guan-Yu Jiang[1] ([1]National Yunlin-University of Science and Technology, Taiwan, [2]National Formosa University, Taiwan)

The delta robot synchronous control based on the Ethernet Control Automation Technology (EtherCAT) protocol is proposed in this paper. Personal Computer (PC) is used as master and the delta robot motor drivers are used as slaves in this work. The Master sends command to slave base on the motion control profile CAN in Automation 402(CiA402). Subsequently, the program in C# perform the user's interface and EtherCAT communication. And the system is not only easy use, but also quickly high-precision. A complex painting application is proposed to show this system workable.

OS24-2 Web-based SCADA using MQTT Protocol and AES
Jr-Hung Guo, Tzu-Yuan Lin, Kuo-Hsien Hsia
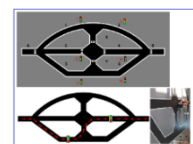(National Yunlin-University of Science and Technology, Taiwan)

Internet of Thing (IoT) technology is a very popular research topic. Especially in the application of Industry 4.0, it is the most basic and important part. However, related security and application system development often have many problems. Therefore, this paper uses MQTT protocol and AES encryption technology to develop a Web-based SCADA system. This Web-based SCADA uses drag-and-drop operation, and users can quickly build a WYSIWYG (What You See Is What You Get) application system. And by collecting different communication protocols and integrating multiple communication interfaces, this SCADA can be connected to many PLCs and other equipment. Allow the industry to build application systems quickly and at low cost.

OS24-3 Smart Identification System of Teaching-type Autonomous Vehicles
Chun-Chieh Wang (Chienkuo Technology University, Taiwan)

Today's image recognition technology has been used in many engineering fields. Especially the image recognition combined with the automatic driving system can bring greater traffic convenience to people. To improve the teaching efficiency of autonomous driving image recognition technology, a self-driving car intelligent identification system suitable for teaching has been developed in this article, so that teachers and students can easily use this system for experiments. As for the main controller of the car body is the Raspberry Pi microcomputer processor. It works with Python for image processing. Image processing techniques include grayscale, binarization, morphology, image cutting, etc. In addition, in order to facilitate teaching, the experimental road field is planned to include 9 paths for self-driving cars to drive autonomously, in this article. To realize the function of self-driving cars, there are four main functional tests in the context setting. It includes road identification, conversion of lane turning arc into front wheel turning angle, intersection identification, and traffic light identification. The experimental results confirm that the developed smart identification system and the experimental environment planning are helpful for autonomous driving related teaching and can enhance students' willingness to learn.

OS24-4 Automatic Anti-Lock Brake System for Anti-Rollover Control of Autonomous Heavy-Duty Truck

Chian C. Ho, Riki Umami Sanaz Ulfitria (National Yunlin-University of Science and Technology, Taiwan)

In recent years, there are more and more rollover accidents about autonomous heavy-duty trucks or autonomous ordinary vehicles in intelligent airports or seaports. These accidents leads to the hot research field about the prevention of rollovers in advance for autonomous vehicles, especially in autonomous heavy-duty trucks. This paper develops an automatic anti-lock brake system (ABS) as one way to stabilize the autonomous vehicle. Then, through monitoring both vehicle's and wheel's speeds, this paper helps the autonomous vehicle keep stability control with automatic ABS even when the wheels halt or slip on the road. This paper adopts TruckSim to model the vehicle safety dynamics and MATLAB/Simulink to simulate the vehicle stability control. Experimental results show that the elaborate automatic ABS proposed by this paper can smoothly keep the vehicle stable even under dangerous road conditions of sharp corner or hairpin turn.
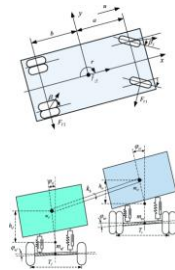
OS24-5 Development of Intelligent Beehive and Network Monitoring System for Bee Ecology

Chau-Chung Song[1], Geng-Yi Lin[1], Chi-Chung Peng[2] and Chung-Wen Hung[3] ([1, 2]National Formosa University, Taiwan, [3]National Yunlin-University of Science and Technology, Taiwan)

In this paper, development of intelligent beehive and network monitoring system for bee ecology is focused on data acquis such as temperature, humidity, weight, and GPS positioning, combining the beehive with MCU, sensors, and ZigBee to implement front end sensing nodes to build a bee ecological network monitoring information system for real-time remote network monitoring, and assist beekeepers to establish a cloud-based real-time monitoring system and history traceability Bee product management system to enhance the convenience of beekeeper management and risk control, thereby effectively improving the efficiency of labor utilization. Also, clear production history information can increase consumers' trust in products and enhance the overall bee-related industry Economic benefits. This paper cooperated with beekeepers in Gukeng, Yunlin County, set up an Intelligent beehive system in the bee farm. Observations in the past month have shown that the activity and number of adult bees and larvae grown in the intelligent beehive are in good condition, user can also connect to the Intelligent beehive monitoring website through their mobile phone, tablet, or computer to analyze and monitor the status of each beehive.

OS25 Information Applications and Cybersecurity (6)
Chair I-Hsien Liu (National Cheng Kung University, Taiwan)
Co-Chair Kuo-Hsien Hsia (National Yunlin University of Science and Technology, Taiwan)

OS25-1 Extendable ICS Honeypot Design with Modbus/TCP

I-Hsien Liu, Jun-Hao Lin, Hsin-Yu Lai, Jung-Shian Li (National Cheng Kung University, Taiwan)

In order to protect the Cybersecurity of Industrial control system (ICS), we design a prototype of an ICS honeypot. All honeypots are controlled by a server, and using the description file to define honeypot's characteristics, to achieve our honeypot system with scalability and high interaction. We compare our honeypot system and Conpot. the results show that the responses of our honeypot system have more interaction. Even more, our honeypot obtained a perfect score in the honeypot scoring mechanism of Shodan.

OS25-2 Industrial Control System Cybersecurity Testbed with TSN Feature

I-Hsien Liu, Li-Yin Chang, Jung-Shian Li (National Cheng Kung University, Taiwan)
Chuan-Gang Liu (Chia Nan University of Pharmacy & Science, Taiwan)

Time sensitive networking (TSN) is the future industrial network trend, under the development of the future Industry 4.0. and a large number of Internet of Things. How to ensure the transmission delay and jitter of the packet will be a major issue. A key feature of TSN is the traffic scheduling mechanism,which can accommodate hard real time streams of critical data with bounded end to end delays. In this work we have setup a TSN testbed to implement TSN. IEEE 802.1 TSN standard includes precise clock to sync, bandwidth reservation, and traffic shaping, which provide high reliability, low latency and other industrial needs. IEEE 802.1Qbv standards use some mechanisms to handle scheduled traffic jitter and critical traffic latency. We focus on testing and implementing 802.1Qbv standard.
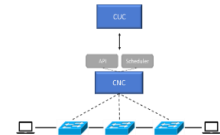
OS25-3 Using the Modified Delphi Method to Construct the Quality Indicators of the Counseling Service System

Li-Min Chuang, Hsiu-Hao Liu (Chang Jung Christian University, Taiwan)

The counseling service system is a case management tool used by professional guidance counselors and full-time teacher-counselor. However, the system satisfaction and willingness to use were generally low. This study used the modified Delphi method to construct the quality indicators of the counseling service system. The study found the quality indicators of the system can be divided into five major dimensions and 23 evaluation indicators to explore. There were three indicators most valued by experts and users, which were the functions are simple and convenient to operate, the project meets the needs of the work, and the efficiency and convenience of paper processing are improved. Based on the research results, this study puts forward substantive implications for academics and management.

OS25-4 The Key Success Factors of Introducing ERP System in Taiwan's Manufacturing Industry

Li-Min Chuang, Yu-Po Lee (Chang Jung Christian University, Taiwan)

This study examines the key success factors of ERP introduction in Taiwan's manufacturing industry as a reference for enterprises to reduce the high and unforeseeable financial and time costs of ERP introduction. In the second phase, a questionnaire study was conducted using the Analytic Hierarchy Process to extract the relative weights of the distance between primary and secondary dimensions, and 5 primary dimensions were derived, including "Management/Organization", "Introduction Process", "Technical Support", "Documentation", and "Personnel", as well as 15 secondary dimensions.

OS25-5 The Fuzzy AHP approach for intelligent building assessment model

Li-Min Chuang, Yu-Po Lee (Chang Jung Christian University, Taiwan),
Chien-Chih Kuo (Chien Chang Construction Co., Ltd.)

The main objective of this thesis is to probe into how Taiwanese building investment and development companies rate the analytical framework and weights of artificial intelligence buildings. Document Analysis, the Delphi method, and the Fuzzy Analytic Hierarchy Process (FAHP) are applied to conduct a FAHP questionnaire survey among 20 building investment and development companies in Tainan. Based on the calculation of composite weights, the findings are: (1) The most crucial evaluation indicator for security and hazard prevention is the "access control system". (2) The most crucial evaluation indicator for energy-saving management is "energy-saving technology". (3) The most crucial evaluation indicator for health and comfort is the "interior comfort system". (4) The most crucial evaluation indicator for intelligent innovation is the "intelligent innovation concept".

Dimension	Weight
Security & hazard prevention	0.375
Energy-saving management	0.303
Health & comfort	0.164
Intelligent innovation	0.158

OS25-6 Blockchain-based Verification Mechanism for Industrial Control System

Yao-Chu Tsai, I-Hsien Liu and Jung-Shian Li (National Cheng Kung University, Taiwan)

Industrial control systems (ICS) and critical infrastructure have become increasingly dependent on communication networks and cyber-physical systems. Since infrastructure is vulnerable to natural disasters, physical destructions, and adversarial attacks, the research on cybersecurity is vital in Industry 4.0. In order to secure the integrity of data in ICS, this paper proposes a blockchain-based network architecture implemented on physical industrial equipment. By the arrangement of the blockchain transaction process in the specialized client-server network model, industrial control signal transmission can be verified based on authority. The transaction logs would not be easily tampered with due to the characteristics of blockchain, and the data integrity could be assured.
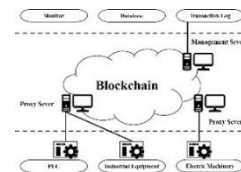
# OS26 Intelligent Life and Data Analysis (6)

Chair I-Hsien Liu (National Cheng Kung University, Taiwan)
Co-*C*hair Chu-Fen Li ((National Formosa University, Taiwan)

OS26-1 Data Balanced Algorithm Based on Generative Adversarial Network

I-Hsien Liu, Cheng-En Hsieh, Wei-Min Lin, Jung-Shian Li (National Cheng Kung University, Taiwan), Chu-Fen Li (National Formosa University, Taiwan)

In order to defend against malicious attacks, intrusion detection systems have introduced machine learning as a protection strategy. However, machine learning algorithms and datasets have a great influence on the effectiveness of the machine learning model. This study uses five algorithms which are Naïve Bayes, CNN, LSTM, BAT, and SVM to train the IDS machine learning model. We use three datasets which are NSL-KDD, UNSW-NB15, and CICIDS 2017 to train and evaluate the model performance. We design a data-balanced method based on the GAN algorithm to improve the data imbalance problem of the IDS dataset. Also, we use the method to generate labels, these labels are used to explain the clustering effect of the unsupervised model.
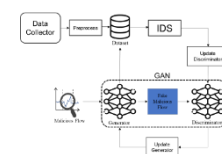
OS26-2 Fault-Tolerant Control System Design for Nonlinear System with Actuator Faults

Ho-Nien Shou (Air Force Institute of Technology, Taiwan),
Hsin-Yu Lai (National Cheng Kung University, Taiwan)

This article deals with observer-based integrated robust fault estimation and accommodation design problems for nonlinear system. The environmental disturbance torque, actuator faults, sensor faults and model uncertainties are considered. Firstly, we propose the augmented fault estimation observer (AFEO) to guarantee the convergence of H∞ performance index of fault estimation and to restrict the influence of uncertainties with respect to the fault estimation error as well. We then design the fault accommodation which is based on the dynamic output feedback to keep the stability of the closed-loop system while malfunctioning. AFEO and dynamic output feedback fault tolerant controller (DOFFTC) are separately designed. Their performances are separately considered. Finally, we propose a simulation result of the micro-satellite attitude control system to demonstrate the effectiveness of the presenting method.

OS26-3 Key Indicators for Successful E-Oriented Operation and Management of the Nutrition Consulting Service System

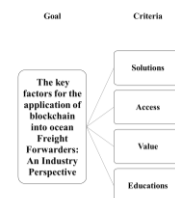Ling-Mei Hsu (Chang Jung Christian University, Taiwan)

According to the application theory of information systems, it is a tendency that the e-management of the nutrition consulting service industry by the Internet generation, and service quality is the key indicator of operational performance, which is of great importance. This research purpose was to analyze the key dimensions of online service quality when customers were learning online. This research used the E-SERVQUAL to design five major dimensions and 15 criteria, and through the analytic hierarchy process (AHP) constructed a set of successful operation management modules. This research verified the order of the key indicators were: Security/Privacy, Reliability, Reactivity, Efficiency, Tangibility.
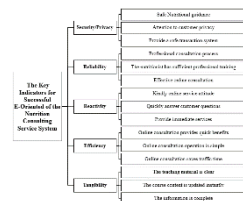
OS26-4 The key factors for the application of blockchain into ocean Freight Forwarders: An Industry Perspective

Chu-Ting Hsu, Ming-Tao Chou, Ji-Feng Ding (Chang Jung Christian University, Taiwan)

Blockchain is an emergent technology concept that enables the decentralized and immutable storage of verified data and is often considered to be applied to help the maritime industry to manage innovation. This study subdivided the four dimensions into 20 appropriate evaluation indicators. The indicators of key factors based on the results are as follows: 1. "The application of blockchain will reduce intermediary costs and increase revenue when switching transportation vehicles." 2. "Using blockchain will save a lot of manpower and correspondence in the traditional model, and build trust, and fully secure information. "Ocean freight forwarders can explore the standard service model as a reference to build competitive advantages and ensure sustainable business decisions.

OS26-5 Key Success Factors for Implementation Quality Assurance of Information Technology in Tourism Industry

Shuen-Huei Yao, (Chang Jung Christian University, Taiwan), Cheng Chung Yeh
(National University of Tainan, Taiwan), Wen Jung Tsai (Chang Jung Christian University, Taiwan)

With the constant change nowadays, various enterprises are facing such a fierce competition that they have to seek for competitive advantages and core competitiveness. With respect to consumers, the implementation quality assurance based on the technology system platform in tourism industry. In order to figure out for implementation quality assurance of information technology in tourism, the Delphi method is applied in this research. For the weights and priorities of various measurement indicators are compared through AHP. According to the results, "training professional tour guides", "foreign language and translation skills" are the most critical success factors for the implementation quality in tourism industry. Besides, it hoped results can provide suggestions for the actual implementation and management of the platform.
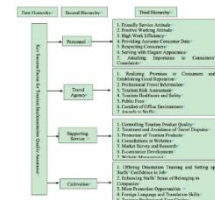
OS26-6 AI Big data analysis and application: Patient Safety Culture of Nursing Staff in an Operation Room

Su-Chiu Hsiao (Chang Jung Christian University, Taiwan)

The objectives of this study were to investigate patient safety attitudes among operation Room (OR) nursing staff by using the Safety Attitudes Questionnaire (SAQ) and to compare their safety attitudes with the entire hospital nurses'. This study investigated the factors affecting patient safety attitudes by the multivariate regression models. There was a significant association between resilience and safety climate after adjusting for age, gender, and career experience using the multiple-regression model. Perception of management was also significantly associated with job satisfaction. The survey data provide baseline information on OR nurses. The results can be used to follow-up on the effectiveness of quality improvement campaigns, caring Strategy, and patient safety education in the future. Establish a caring notification system. Achieve effective management.

OS27 Environmental Monitoring (5)
Chair Kazuo Ishii (Kyushu Institute of Technology)
Co-Chair Keisuke Watanabe (Tokai University)

OS27-1 Biofouling Monitoring Experiments of Underwater Concrete Samples for Offshore Platform Cleaning Robot Development

Keisuke Watanabe[1], Hiroki Goda[2], Koji Harada[3]
([1]Tokai University, [2]Kyusyu Institute of Technology, [3]Nishimatsu Construction Co., Ltd., Japan)

As the Japanese government decided to boost the carbon neutral power source development, offshore wind farm projects are emerging in Japan and hundreds of platforms will be constructed in the near future. Some of these platforms are possible to be floating structures and made of concrete-like material whose biofouling should be limited from the viewpoint of drag force reduction. An autonomous cleaning robot is one of possible solutions to minimize the effect of biofouling. To develop the cleaning device, we started field experiments to study biofouling process. In this paper, we introduce some results of biofouling monitoring experiments using several different concrete-like samples at sea.

OS27-2 Fall risk notification system using LiDAR sensor for the visually impaired people

Daigo Katayama[1], Kazuo Ishii[1], Shinsuke Yasukawa[1], Satoshi Nakadomari[2], Koichi Wada[2], Akane Befu[2], Chikako Yamada[2] ([1]Kyushu Institute of Technology, Japan, [2]NEXT VISION, Japan)

We have developed the fall risk notification system using LiDAR sensors to reduce the number of fall accidents on platform involving visually impaired people. This system contains of iPhone 12 Pro with the small LiDAR sensor and the cane grip vibration device that notifies the user of fall risk using vibration. In this paper, we report the experiment results of the environment recognition algorithm for the fall risk notification system. In this system, the height map is generated from the depth information obtained from the LiDAR sensor and the posture of the iPhone. The system then performs the threshold process based on the height of the iPhone from the road surface during use. In the experiment, we evaluated the detection accuracy and responsiveness when entering risky area of falling, such as stairs and gaps.

OS27-3 Reflection Coefficient Estimation through the Modelling of Ultrasonic Transmission

Ryuugo Mochizuki, Yuya Nishida, Kazuo Ishii (Kyushu Institute of Technology, Japan)

In food industry, shortage of working force is one of a critical problem. As a background, in Japan, increasing single households and demands for prepared dishes are relevant, thus, automation of food packing is a challenge. As the automation, food picking operation must be done safely without damaging food by robotic hand. We propose non-contact acoustic estimation with ultrasonic wave before the picking, having assumption of the relationship between hardness and acoustic impedance, that is, the product of density and sonic velocity. Furthermore, larger reflection coefficient can be observed from media of higher acoustic impedance. We built up ultrasonic transmission model considering attenuation by reflection and absorption, then, made an experiment with two overlapped media to configure the change of reflection coefficient at the surface of lower medium depending on its acoustic impedance. As the result, larger reflection coefficient changed according to rising acoustic impedance of the lower medium.
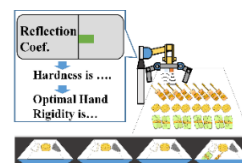
OS27-4 Evaluation of Maps Constructed by Crawler-type Agricultural Robot in Different Farms

Takuya Fujinaga, Tsuneo Nakanishi (Fukuoka University, Japan)

Various studies have been carried out with the aim of realizing smart agriculture. Many of them have targeted at large fields and large-scale facilities that are relatively easy to verify and implement robots and IoT devices etc. On the other hand, although the ratio of small-scale facilities is high in Japanese agriculture, there are few cases of study targeting small-scale facilities. We aim to develop an agricultural robot for supporting agricultural work that can move autonomously in the field for small-scale vinyl house. This paper evaluates maps of three different environments (strawberry farm, herb farm and vegetable farm) constructed using the developed agricultural robot. In addition, through verification experiments and evaluation results, we describe the requirements and concerns for operating robot in small-scale vinyl house.

OS27-5 An Estimation Method of Coastal Ocean Debris Using Aerial Drone

Kazuo Ishii[1], Kanako Shirahashi[1], Yuya Nishida[1], Moeko Tominaga[2], Yoshiki Tanaka[1], Dominic B. Solpico[1]
([1]Kyushu Institute of Technology, Japan, [2]Nishinippon Institute of Technology, Japan)

Although the actual situation of ocean debris has not been measured accurately, innumerable ocean garbages are drifting in the ocean. Especially, non-perishable waste such as microplastics continues to grow and is damaging marine life, including endangered species, and some are washed ashore and causing pollution damage to coastal areas. Microplastics incorporated into marine organisms, Arctic sea ice, and deep-sea seafloor sediments have also been detected. The Ellen MacArthur Foundation in the United Kingdom estimates that the total amount of marine debris exceeds 150 million tons, with more than 8 million tons of new inflow each year. We measured and compared the amount of ocean debris in coasts in Hirado and Matsuura cities, Nagasaki with manual count and an aerial drone observation.
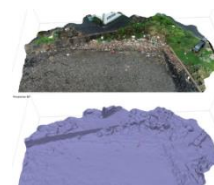
OS28 Robot Competitions and Education (6)
Chair Kazuo Ishii (Kyushu Institute of Technology, Japan)
Co-Chair Yasunori Takemura (Nishinippon Institute of Technology, Japan)

OS28-1 Underwater Acoustic Positioning Based on MEMS Microphone for a Portable Autonomous Underwater Vehicle

Irmiya R. Inniyaka, Dominic B. Solpico, Daiki Hamada, Akihiro Sugino, Rikuto Tanaka, Yuya Nishida, Kazuo Ishii (Kyushu Institute of Technology, Japan)

Autonomous Underwater Vehicle positioning is important for accurate control and high-quality data collection during operation. Conventional acoustic positioning systems are expensive. This paper describes the design and performance results of an inexpensive acoustic system for a lightweight AUV "Kyubic" used in Underwater Robotic competition, Okinawa 2021. The positioning method is based on Super-short baseline (SSBL) principle. The system design comprises of self-made hydrophone (3) module using MEMS microphone, ReSpeaker 4-mic array, Raspberry pi, and isolated power supply module. Using Python, the distance and angle of processed acoustic signals are integrated for dynamic control strategy of AUV to locate the position of a Pinger (acoustic pulse generator).
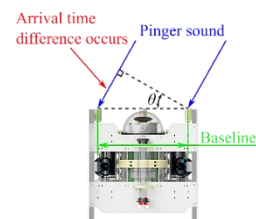
OS28-2 Autonomous Underwater Vehicle with Vision-based Navigation System for Underwater Robot Competition

Kazuki Harada, Riku Fukuda, Yusuke Mizoguchi, Yusuke Yamamoto, Kouta Mishima, Yoshiki Tanaka, Yuya Nishida, Kazuo Ishii (Kyushu Institute of Technology, Japan)

An Underwater Robot Competition (URC) is organized as the concurrent event of Techno-Ocean 2021 to advance underwater technology. The URC has two leagues, Autonomous Underwater Vehicle (AUV) and Free style robot leagues, and our team, Kyutech Underwater Robotics, jointed the AUV league using the developed AUV. The missions of AUV league consist of Gate Pass colored by green, Buoy Touch with the yellow and red colors, and Homing to a Pinger. Our AUV tackles the missions based on a vision-based navigation system. The paper explains the AUV system, the mission strategy and detail of image processing.
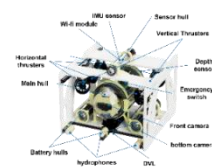
OS28-3 Tomato Harvesting in Greenhouse Considering the Effect of Sunlight

Kai Shioji, Shinsuke Yasukawa, Kazuo Ishii (Kyushu Institute of Technology, Japan)

Tomato is one of the important fruit vegetables and most tomatoes are produced in the greenhouses, or large-scale farms, where the high temperature and humidity, and long harvest age force the farmer heavy works. To develop the tomato harvesting robot, many research issues exist such as manipulator design, end-effector design, collaborative behavior, artificial intelligence, motor control, image processing, target recognition and so on. For the operation in greenhouses, the recognition system with color constancy under sunlight is necessary. In the harvesting, tomatoes should be handled gently for less damages so that the soft handling end-effector is needed. In this paper, we introduce the system configuration of the robot and the experiments conducted to solve the problem in the greenhouse.

OS28-4 Inter-University Collaboration Aimed at Integrating Different Robotic Fields: Development of Underwater Robots and Soccer Robots Through these Competitions

Moeko Tominaga[1], Jonghyun Ahn[2], Yasunori Takemura[1], Kazuo Ishii[3]
([1]Nishinippon Institute of Technology, Japan, [2]Hiroshima Institute of Technology, Japan, [3]Kyushu Institute of Technology, Japan)

In robotics, the problems and solutions to be focused on may differ due to the different fields of robots to be developed. This is a phenomenon that appears depending on the operating environment of the robot, but it may be applicable to various fields. Also, the development factors that the students focus on differ depending on the university or laboratory the students belong to. In this research, we will verify the effect of exchanging opinions and sharing knowledge by collaborating with students aiming to participate in different robot competitions between underwater robots and soccer robots. Due to the influence of Covid-19, the robot competition was held online, and the cooperation between universities that had been continued online became possible on the day of the competition. This report was analyzed and evaluated based on the results of regular questionnaire monitoring of students' willingness to work on projects and activity records.
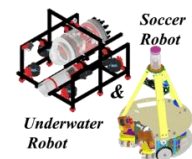
OS28-5 Exercise on Environmental Monitoring and Control of Greenhouse by IoT Devices toward Smart Agriculture

Yuya Nishida, Ryugo Mochizuki, Shinsuke Yasukawa, Kazuo Ishii (Kyushu Institute of Technology, Japan)

In the future estimation of 2050, the food demand increases 70% and the production decreases 15% caused by global warming, and farmer population be 1/5 of current workers. We need an agricultural system of twice production with the same farmland area and 5 times effective operations until 2050. For the sustainable society, smart agriculture including robot technology, AI, IoT is one of the solutions for food issues. As crops in greenhouses are widely distributed, IoT devices placed near the crops should be stand-alone and modular, and data from the devices are collected over the networks. Camera is often used for monitoring of growth status of the crops, and only resulted information by image processing should be transmitted. Smart agriculture requires knowledge of a wide range of fields including electricity, information, and image processing. We have designed an AI and IoT technology exercise on environmental monitoring and control of a greenhouse where we have been preparing for grow up of tomatoes and other vegetables.
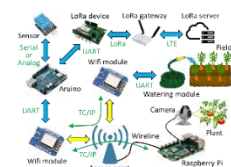
OS28-6 Evaluation of roller arrangement of sphere by omnidirectional integral value

[1]Kenji Kimura, [2]Yusuke Abematsu,[3]Hirai Hiroyasu, [3]Kazuo Ishi
([1]Fukuoka Daiichi High School, Japan, [2]Kagoshima Gyokuryu High School, Japan,
[3]Kyushu Institute of Technology, Japan)

The conventional sphere moving mechanism driven by a constraining roller has a fixed roller rotation axis, so the angular velocity vector has two degrees of freedom. Here, if the degree of freedom is 3, the rotational diversity of the sphere increases. In this study, we propose a spherical mechanism with variable roller rotation axis and consider the problem of spherical transport with the best kinetic energy efficiency. At this time, using the kinetic energy integration in all directions (direction of travel of the sphere) as an evaluation function, the evaluation distribution of the roller contact position is considered, and the conventional mechanism is compared with the variable mechanism.
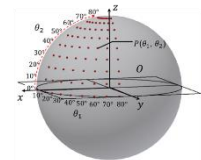
## OS29 Advances in Marine Robotics and Their Applications (8)
Chair Keisuke Watanabe (Tokai University)
Co-Chair Kazuo Ishii (Kyushu Institute of Technology)

OS29-1 A Sensor Network to Estimate Fish Activity and Assist Feeding Decisions in Marine Aquaculture

Dominic B. Solpico, Yuya Nishida, Kazuo Ishii (Kyushu Institute of Technology, Japan)

Fish feeding is one of most important issues in marine aquaculture. Satiety feeding causes high expenses and ocean pollution so that optimization of feeding and DX of expert farmers are necessary toward sustainable marine aquaculture. Currently, the decision-making has been based on subjective experience of expert farmers. This paper presents the development of a sensor network for estimating fish feeding behavior, which could help in optimize feeding by less experienced farmers. This network is made up of arrays of sensor modules consisting of current sensors, inertial measurement units and cameras. We introduced this system in fish cages and measured fish activity from start to end of feedings. Experiment results indicate that currents were highest at the surface at the feeding proper, rising and dropping around when feeding started and ended, respectively. Expert farmer finds a small fish behavior change and stop the feeding, whose timing is also suggested from obtained data.
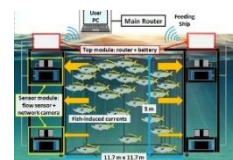
OS29-2 Proposal of a Swarm Intelligent Underwater Glider System for a Long-term Three-dimensional Wide-area Ocean Observation

Kanako Kobatake, Masakazu Arima (Osaka Prefecture University, Japan)

The ocean absorbs heat and carbon dioxide from the atmosphere, and it serves to mitigate climate change caused by human activities. However, ocean is currently facing serious threats due to global warming and ocean acidification. In order to conserve ocean, it is very important to have a correct understanding of the ocean environment conditions over a long term and wide area. In this research, the authors propose a swarm intelligent underwater vehicle system for a long-term three-dimensional wide-area ocean observation. Several cases of underwater cruise simulation using the autonomous underwater glider with independently controllable main wings, SOARER, were carried out for the validation of the effectiveness of the proposed system, and estimated the optimal required number of vehicle that cover the Japan's EEZ.
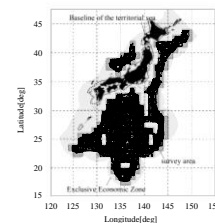
OS29-3 Underwater Acoustic Communication using QPSK Modulation Method

Yuya Nishida, Yuichiro Uemura, Rikuto Tanaka, Kazuo Ishii (Kyushu Institute of Technology, Japan)

Acoustic transmission has less attenuation than those of radio or light and is commonly used for communication between underwater robots. However, acoustic communication has a lot of influence of noises, and difficulties in sending and receiving data correctly because of the noise from robot's thrusters and other acoustic devices, and its baudrate is only 1/1000 of conventional Wi-Fi communication. To improve the acoustic communication performance, this research developed acoustic communication system against the thruster's noise. The acoustic communication system consists of a transducer, two Amp circuits, device including A/D and D/A convertor, and PC for modulation. Communication message includes not only data (payloads) but also sync signal and error correction bytes, and the message is converted to acoustic wave by QPSK modulation which four phase data represent two bits.
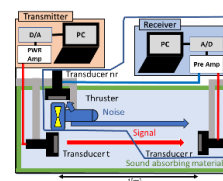
OS29-4 Ultrasonic Cleaner using Two Transducers for Ship Hull Cleaning Robot

Yuya Nishida, Toshihiro Matsumura, Kazuo Ishii (Kyushu Institute of Technology, Japan)

Fuel consumption of the ship gets worse by barnacles and stains put on its bottom, so that the ship hull should be cleaned regularly. Usual methods such as cleaning by special divers and cleaning after pulling up to the dock are not used frequently due to those high cost and the heavy burden on cleaners. We proposed a cleaning method using underwater vehicle with brushes, however there is a possibility to remove paints on the hull. To improve cleaning performance of the underwater vehicle, the ultrasonic cleaner is developed by using cavitation occurred by sound waves of the acoustic transduces. The cleaner generates sound waves with sound pressure of 0.2MPa or more required to occur cavitation at the point where sound waves from two transducers overlap. In experimental results, the cleaner occurred cavitation enough to make two holes in the aluminum foil located 50mm away from transducers.
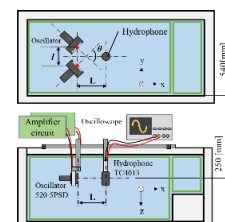
OS29-5 Motion Control of a Ship Hull Cleaning Robot

Hyoga Yamamoto, Yuya Nishida, Takayuki Matsuo, Kazuo Ishii (Kyushu Institute of Technology, Japan)

Recent trend towards increased cost of fuel will continue further, so the reduction of fuel consumption will be required more severely as well as the severe requirement of reduction of CO2 emissions. To achieve these requirements, the reduction of resistance is essential for efficient ship navigation. One of solution is the prevention of marine biofouling. Anti-fouling paint is effective to prevent biofouling to the ship hulls like barnacles, however, even the painted hull acquires slime-like biofouling caused by marine alga on its surface easily. The cleaning of the ship hull is generally carried out during inspection in dockyard once a year. Frequent cleaning while the ship is berthing is desirable to keep good fuel efficiency. If frequent ship hull cleaning is possible while ships dock at berth with ease, ships can keep good fuel efficiency that makes the transportation costs and CO2 production less. Cleaning by divers costs much and is a high risk task. One possible solution for this issue is to introduce underwater robots for ship hull cleaning. In this paper, the motion control system of the robot is described.

OS29-6 Development of a USV Testbed and Its System Check Experiments at Sea

Keisuke Watanabe, Masatoshi Shimpo (Tokai University, Japan)

The catamaran type USV is useful as an autonomous platform in the field of marine engineering, such as collection of marine waste in ports, ocean observation platforms, and automated vessels for offshore wind farm maintenance. The authors have been developing an experimental testbed of USV platform to conduct basic studies on control algorithms by simulation as well as hardware systems to conduct sea experiments. In this paper, we report on the construction of an actual sea area experimental system and basic experimental results.

OS29-7 Development of a Seabed Walking Platform for Ore Sample Drilling in Deep Sea Mining

Keisuke Watanabe[1], Hideyuki Suzuki[2], Yoshiyasu Watanabe[1]
([1]Tokai University, Japan), ([2]The University of Tokyo, Japan)

In deep-sea mineral resource development, exploratory drilling is indispensable for estimating the amount of resources. In order to reduce the cost of exploration, a system for drilling on the seabed is needed instead of a support vessel at sea. This exploration platform must be able to move along with the undulations of the seafloor and have a structure that supports the reaction force of the excavation. The authors have been studying an eight-legged drilling platform. This paper introduces the system configuration of an eight-legged walking robot.
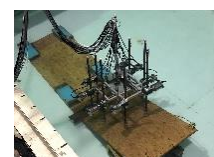
OS29-8 Development of Remotely Operated Vehicle for Small-size Jellyfish Extermination and its Evaluation of Extermination Motion Control

Hiroyuki Yokota[1], Shinsuke Yasukawa[2], Jonghyun Ahn[1]
([1]Hiroshima Institute of Technology, Japan, [2]Kyushu Institute of Technology, Japan)

In recent years, increase in the number of jellyfish has caused damage in the fishery and tourism industries. Therefore, the extermination work of jellyfish is being carried out by human hands. However, conventional methods for extermination are required a lot of time and manpower. In this paper, we propose a method for extermination work of jellyfish using underwater robot. Also, we introduce developed ROV type underwater robot, which is called J.E.N.O.S., and its extermination motion control. The J.E.N.O.S. is developed in consideration of the attitude control during the extermination operation. Because, the attitude, such as surge and pitch angle, of J.E.N.O.S. becomes unstable when performing jellyfish extermination. Therefore, we equipped 8 thrusters to improve attitude stability during the jellyfish extermination. As a result, surge acceleration is reduced to about 30.0%, and pitch angle velocity is reduced to about 25.8%.
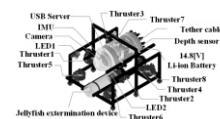
OS30 Intelligent Systems and Robotics -4-(6)
Chair Jichao Zhao (Tianjin University of Science and Technology, China)
Co-Chair Hucheng Wang (Tianjin University of Science and Technology, China)

OS30-1 A Design of Micromouse Control System
Hucheng Wang (Tianjin University of Science and Technology, China)

This paper improves the problems of the traditional computer mouse, such as the vehicle weight, inflexible turning, and the sensor can not accurately feed back the external environment information. In terms of machinery, the solid, durable and light-weight material is used as the vehicle body, and the transmission mode adopts belt indirect transmission, so that the computer mouse has a lighter, more stable and more flexible structure. The sensor module is optimized to make it more sensitive and accurate to perceive the external environment. The software part uses the potential value search algorithm, combined with the external information collected by the infrared sensor, so that the computer mouse can sprint from the starting point to the focus more quickly. This paper also innovatively adds the voltage detection module, which solves the problem that the traditional computer mouse can not know the remaining power in the competition, and ensures the stability of power supply.
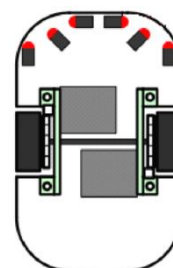
OS30-2 A Driver Reaction Time Detection System Design
Yuhui Cheng[1], Mochi Li[2]
([1] Tianjin University of Science and Technology, China), ([2] Ocean University of China, China)

This paper proposes a design scheme of driver reaction time detection system, which collects electroencephalography (EEG) data and reaction time required by the driver to complete corresponding test actions by deploying sensors on the driving simulator. The scheme can be divided into control unit, data acquisition unit and interaction unit. The test performs corresponding operations according to the instructions issued by the interaction unit, and the system sorts out and saves the collected data. This system is of great significance to study the reaction time of drivers in different states and scenarios.

OS30-3 A PID Tracking Car Design based on STM32

Yande Xiang, Teng Zhang, Shixiang Zhao, Ling Zhou, Mingjuan Tian, Haoran Gong
(Tianjin University of Science and Technology, China)

Intelligent car is a high-order intelligent product integrating intelligent integrated control, visual terminal, automatic control output and cognitive computing. This paper introduces an innovative intelligent tracking car based on STM32 embedded chip. The vehicle adopts fuzzy PID algorithm to control the vehicle operation, and adopts the innovative grayscale card designed by the team hardware designer. This car fully caters to the global environmental protection trend, the new concept of green development. On the premise of low cost and low power consumption, it also ensures the smooth, smooth and high precision operation of the vehicle.
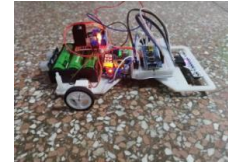
OS30-4 Matrix Approach to Current-state Detectability of Discrete-event Systems

Jinliang Wang, Jiawei Wei, Xiaoguang Han (Tianjin University of Science and Technology, China)

In our previous work, a matrix-based framework is proposed to tackle the problem of verifying strong detectability in the context of partially-observed nondeterministic discrete event systems (DESs). Two key concepts, namely, unobservable reach and detector, are redefined therein. Also, the dynamics of a detector, under the frameworks of the Boolean semi-tensor product of matrices, are converted equivalently into an algebraic representation. In this paper, we extend our previous work to other versions of detectability, including strong periodic detectability, weak detectability, and weak periodic detectability. Several necessary and sufficient conditions are derived for verifying aforementioned three types of detectability, respectively. Compared with the existing ones, the proposed methodology is easier to be implemented in software in the sense that it avoids the symbolic manipulations. Finally, an example is given to illustrate the theoretical results.
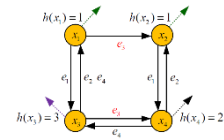
OS30-5 Hardware Circuit Design Of Tracking Car Based On K60

Peng Jia, Yande Xiang (Tianjin University of Science and Technology, China)

The development of the robot industry is booming. For many repetitive and difficult jobs, using industrial robots to complete them can greatly save money, manpower and time costs. Industrial tracking vehicle AGV has been applied in many fields and has shown good results. Taking the industrial AGV as the model, this paper analyzes the actual needs, explores, designs and builds a set of hardware model of intelligent tracking car based on K60. The main work includes hardware circuit scheme design, component selection, schematic diagram and PCB design, PCB board welding.

OS30-6 Detachable IoT Garbage Sorting Device Based on Machine Vision

Tao Zhu, Yang Su, Zhiqing Xiao, Fengzhi Dai (Tianjin University of Science and Technology, China)

China is promoting a garbage sorting system, but people have to spend more time changing their habits, and the garbage bins on the road do not have the function of automatic sorting. Therefore, a detachable IoT waste sorting device based on machine vision is proposed. Through machine vision and a unique mechanical structure design, it can be directly installed on existing trash cans, and is suitable for two and four classifications that meet the Chinese classification standards. Inside the device, it is fixed with an existing trash can with a mechanical electronic lock, and the switch lock operation can be performed through the mechanical key and the Internet of Things applet, which is convenient for the replacement of the device.

OS31 Approaches to Post-Narratology that Combines AI and Cognitive Science with Narratology (9)

Chair Jumpei Ono (Aomori University, Japan)
Co-Chair Hiroki Fxyma (Tainan University of Technology, Taiwan)
Co-Chair Takashi Ogata (Iwate Prefectural University, Japan)

OS31-1 Story Units of the Types of Japanese Folktales and the Combination with a Noun Conceptual Dictionary

[1]Jumpei Ono, [2]Motoki Kumagai, [2]Takashi Ogata
([1]Aomori University, Japan), ([2]Iwate Prefectural University, Japan),

Story units in this study mean units described by Common Lisp based on the types of folktales analyzed by Seki and his group. In particular, we have been developing story units to use in our narrative generation system, namely an Integrated Narrative Generation System (INGS), as a type of narrative techniques that generate a narrative structure based on the synthesis, transformation, expansion, etc. of a narrative structure. Story units function in INGS through the combination with the conceptual dictionaries in INGS. We have attempted the combination of story units with the verb conceptual dictionary. The objective of this paper is the combination with the noun conceptual dictionary. As the main constitutional elements of each story unit are verb and noun concepts, their combinations with the noun conceptual dictionary enable the substantial function of story units based on the types of Japanese folktales as a group of narrative techniques in INGS.

OS31-2 Visualization of the Unconscious in Quality Inspection in Manufacturing

Jun Nakamura (Chuo University, Japan)

In quality inspection, which is the final stage of the manufacturing process, there is an operational manual on how the object should be inspected. In this study, we followed the gaze of the workers to search for the "way of looking" at the objects to be inspected, which is not described in the manual. As a result of experiment, we found a difference between the reciprocating eye movements that occur in skilled worker and the static state of newcomers. It is suggested that this indicates a way of looking at inspection that has been unconscious until now.

OS31-3 The Study on the Relationship Between the Comic Artists' Styles and the Visual Languages: From the Stylistic Changes in the Work of Japanese Comic Artists
Kaori Otsuru (Tainan University of Technology, Taiwan (ROC))

As a first step for the machine-based comics analysis, we propose approaching the stylistic aspects of comics from the framework of linguistics and narrative theory. Machine learning has been applied to paintings and text mining, but comics, a synthesis of these works, contain elements that cannot be analyzed simply by integrating pictures and texts. In this study, I propose a broad definition of the "style" of comics as covering the following concepts; the micro/macro-level development of the story and composition of comics, the synchronous/diachronic changes in drawing, and the impressions of the work obtained through the manga works. This study is intended as a basis for future research on manga style using machine learning.

OS31-4 Theoretical Backgrounds toward Text Mining for a Phenomenological Model of Taste Perception
Hiroki Fxyma (Tainan University of Technology, Taiwan)

In this presentation, I discuss the temporal aspects of cognitive content generation and appreciation of taste. The cognitive content of taste evolves chronologically, as does the appreciation of music. However, the time which is reconstructed and given meaning as a story is considered to have a different time axis from the physical time (i.e., linear time, point time, cyclic time, and so on). Toward a chronological model for the taste phenomenon, I examine the language usage in the tasting comments of wine and sake. A lot of tasting phrases potentially include the concept of time. For example, "drifting" indicates continuous time. By examining how temporal terms co-occur with taste elements, I will discuss the model of taste phenomenon.

OS31-5 Why is the Early Detection of Dementia Failed?
Yuki Hayashi (Chiba University/National Institute for Japanese Language and Linguistics, Japan)

To prevent dementia, the early detection is important. However, it's often failed because it's difficult to articulate "dementia" as "dementia" verbally. In this paper, I analyzed semi-structured interview data stored in DIPEx-Japan, a database of personal experiences of health and illness, and discussed the difficulty of early detection of dementia.

OS31-6 Relationship Between World-view and Advertising Techniques
Yoji Kawamura (Kindai University, Japan)

The "world-view" plays an important role in advertising. In this research, we first extracted the keywords of the world-view related to advertising. Next, those keywords were classified by factor analysis, and a regression analysis was performed on the relationship between the classified genres and advertising techniques. 66 keywords related to the world-view were extracted and classified into 8 genres by factor analysis. The characters & product movements, atmosphere, and products (functions, naming & logos) had a great influence on the world-view of the 8 genres. We also quantitatively clarified the advertising techniques related to each genre. These relationships provide implications for planning advertising creatives.

OS31-7 Adjective and Adjective Verb Conceptual Dictionaries in an Integrated Narrative Generation System

Jumpei Ono (Aomori University, Japan), Takashi Ogata (Iwate Prefectural University, Japan)

Although main conceptual types of our previous narrative generation study using conceptual dictionaries were verb and noun concepts, other conceptual types are necessary for the implementation of more precise narrative generation functions. In this paper, we prepare the frameworks for adjective concepts and adjective verb concepts in our narrative generation system called Integrated Narrative Generation System (INGS). Furthermore, we define the information of opposite meaning for each adjective and adjective verb concept. For example, this function will contribute to introduce a type of contrasting rhetoric into narrative generation.
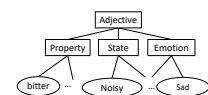
OS31-8 Prototyping Animation System that Combines a Kabuki Work and its Background Story: *Kyōganoko Musume Dōjōji* and the Legend of Dōjōji

[1]Miku Kawai, [2]Shunta Kudo, [3]Jumpei Ono, [2]Takashi Ogata
([1]The Open University of Japan, [2]Iwate Prefectural University, [3]Aomori University, Japan),

Kyōganoko Musume Dōjōji, a famous kabuki dance work, is an adaptation based on the legend of Dōjōji. A series of research regarding Kyōganoko Musume Dōjōji includes many themes, such as the analysis and simulation as an animation system of the stage-performing structure, the survey and analysis of the relationships between Kyōganoko Musume Dōjōji and the legend of Dōjōji, and the design and experimental system development reflected the above relationships. Based on these studies, in this paper, we present an animation-based mechanism that flexibly associates the narrative flow of the stage-performing structure to the story of the legend of Dōjōji.

OS31-9 How Will Art Appreciations Change According to Information Change?

Akinori Abe (Chiba University, Japan),

For the art appreciation in museums, usually a certain information will be provided as a caption. Visitors usually read the description to help his/her understanding. Thus, such a help will be necessary for ordinal person's understanding. Previously, we conducted an experiment to determine viewers' artwork understandings by gradually adding information in caption. In the previous experiment, we offered information only with the official information. In this paper, we will generate information with artists' own writings (artist's explanation). In addition, in this experiment, we used a rather abstract painting and representational but rather strange and difficult to understand paintings. In this paper, I will show how viewers' understanding or interpretation of artworks, and sense of value and preference of artworks change according to the changing information.

# OS32 Human-Machine Interface and Automation (9)
Chair Norrima Mokhtar (University of Malaya, Malaysia)
Co-Chair Fakhrul Hazman Yusoff (UITM, Malaysia)

OS32-1 A Derivative Oriented Thresholding Approach for Feature Extraction of Mold Defects on Fine Arts Painting

Hilman Nordin, Bushroa Abdul Razak, Norrima Mokhtar, Mohd Fadzil Jamaludin
(Universiti Malaya, Malaysia)

Identification of mold defects is an important step in the restoration of damaged paintings. The process is usually lengthy and depends heavily on the qualitative visual judgement of an expert restorer. This study proposes an automatic mold defect detection technique based on derivative and image analysis to assist in the restoration process. This new method designated as Derivative Level Thresholding (DLT) method combines binarization and detection algorithms to rapidly and accurately detect mold from scanned high-resolution images of a painting. The proposed method is compared to existing binarization methods of Otsu's Thresholding Method, Minimum Error Thresholding and Contrast Adjusted Thresholding Method. Experimental results from the analysis of 20 samples from high-resolution scans of 2 mold-stained painting have shown that the DLT method is the most robust with the highest sensitivity rate of 84.73% and 68.40% accuracy.
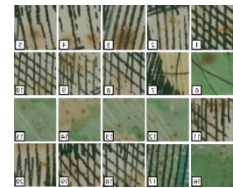
OS32-2 Imaginary Finger Control Detection Algorithm Using Deep Learning with Brain Computer Interface (BCI)

Suresh Gobee[1], Norrima Mokhtar[1], Hamzah Arof[1], Noraisyah Md Shah[1], Wan Khairunizam[2]
([1]Universiti Malaya, Malaysia), ([2]University Malaysia Perlis, Malaysia)

Before the advancement of deep learning technology, the brain signals are to be analysed manually by the neuroscientist on how the brain signals reacts in proportion with human body. This process is very time consuming and unreliable. Therefore, this project aims to develop a brain signal detection based on deep learning algorithm in response to the output of EEG device on the imagery finger movements. These fingers include thumb, index, middle ring and little of right hand. There are four CNN classification models being developed in this project. The different between the models are the pre-processing requirements and neural network architecture. The best results for offline classification obtained in this project are 69.07% and 82.83% respectively in terms of average accuracy from 6-class ad 2-class tests. The developed work can be applied for proof of concept for online study.

OS32-3 Investigating the Effect of Individuality Factors in Measuring Aggresion Induced by Human Brain

Wan Khairunizam[1], Kai Xu tung[1], Lugieswaran[1], Wan Azani Mustafa[1], Hashimah Ali[1], Zuradzman M. Razlan[2], Shahriman AB[2], Norrima Mokhtar[3]
([1]University Malaysia Perlis, Malaysia), ([2]Universiti Malaya, Malaysia)

Aggression is a behavior of human that may cause physical or emotional harm to others. Several factors that cause aggressive behavior such as physical health, mental health and socioeconomic. Many previous researchers reported that aggression could be measured through either questionnaire or the brain signals. This paper proposes the experimental studies to collect the brain signal of the human subject for investigating the effect of individuality in aggression. Ten subjects are selected to perform the aggression activities. The experimental protocol for inducing aggression is proposed. In general, there are four tasks which is collecting brain data in relaxing state before and after the experiments, and data collection while playing game in muted and maximum volume levels. In the experiments, the subject are required to play a popular non-violence smart phone game named "Subway Surfers" and at the same time the EEG signals are recorded from the subject's brain. In the signal pre-processing stage, a Butterworth filter is used to remove the noises contain in the signals. A windowing technique is employed for extracting significant features. A Pearson correlation technique is used to reduce and remain the less and most significant features. In the methodologies, the aggressiveness level A, is defined to investigate the effect of individuality in inducing the aggression signals. The proposed experimental protocol and signal processing techniques are seen able to generate level of aggression.

Figure 1. Mindset 24 EEG amplifier
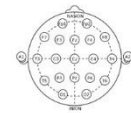
Figure 2. EEG electrode's location according to 10-20 system

OS32-4 Voice User Interface(VuI) Smart Office Door Application in the Context of Covid-19 Pandemic

Muhammad Zharif Aiman Alias, Wan Norsyafizan W. Muhamad, Suzi Seroja Sarnin, Darmawaty Mohd Ali
(University Technology MARA, Malaysia)

Nowadays, all countries around the globe are trying their best to prevent the spread of Covid-19 from reaching their people. However, the virus spread is through the transmission of close contact with the infected person and touching a surface that already contains the virus. This project presents Voice User Interface (VUI) Smart Office Door System that interact with the Internet of Things (IoT) to execute the command given by the user. This project use Raspberry Pi as microcontroller which Thonny Python software used for running the coding script of the system. The electrical components such as dc motors and LEDs are connected to General-Purpose Input Output (GPIO) pin of Raspberry Pi and motor driver. One of the dc motors used for controlling the lock and another one used for controlling the door. Blue LED used as locked door notification while green LED used as unlocked notification. Microphone and speaker connect to the Raspberry Pi through usb port and Bluetooth. This system used Google Assistant as its VUI to control the smart door contactless. The user can give the command to the system through microphone to control the output of the system. The purpose of this project is to invent the smart door with IoT technology that help prevent the spread of Covid-19 at the workplaces.
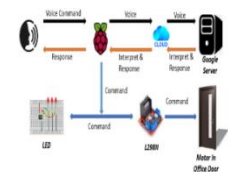
OS32-5 Endometrial Cell Images Segmentation: A Comparative Study

Wan AzaniMustafa[1], Nurul Umaira Salim[1], Wan Khairunizam[1], Shahrina Ismail[1], Hiam Alquran[2] ([1]Universiti Malaysia Perlis, Malaysia; [2]Yarmouk University, Jordan)

Uterine cancer, also known as endometrial cancer, is a form of cancer that affects the female reproductive system. Nowadays, there are 2 step methods that the physician or health care provider tend to use to diagnose cancer, which is using ultrasound technique and endometrial biopsy. The biopsy procedure is used to extract the cell and sent to the pathologist for histopathological image analysis. The histopathological image analysis is the crucial step in all the procedures because it determines the situation for the patient, whether positive or negative. They are two types of cell images known as high grade squamous intraepithelial lesion (HSIL) and low grade squamous intraepithelial lesion (LSIL). The problem occurs when both LSIL and HSIL are different, needing different medical treatment techniques but showing slighter differences in nucleus size cell histopathological image analysis. Therefore, the pathologist usually requires more time to identify whether it is LSIL or HSIL. Based on the limitation, the paper aims to compare a few popular detection methods, which are the Wolf method, Bernsen method, Otsu method and Feng method. Based on the Image Quality Assessment (IQA), the Wolf method shows good performance compared to the others. In a precise term, this finding could benefit the health care community to reduce the diagnosis time to categorize the cell and lead to early treatment of endometrial cancer.

OS32-6 Temperature Control Using Fuzzy Controller for Variable Speed Vapor Compression Refrigerator System

Siti Qurrata Ain Suhaimi, M. Saifizi, S.M. Othman, Azri A. Aziz, Wan Azani Mustafa, Wan Khairunizam
(Universiti Malaysia Perlis, Malaysia)

Keeping the cold chain vaccine is crucial to a stable immunization programme; however, faulty processes may occur more frequently than are often thought in developing nations. This paper discusses the quick and accurate control process for designing fuzzy controllers for variable speed vapor compression refrigerator system. The suggested controller is based on the fuzzy logic intended to improve performance while keeping the cooler's constant internal temperature and increasing the refrigerator efficiency. Despite the external changes such as the outside temperature change or the volume change in the refrigerator vaccine, the fuzzy logic controller is utilised to maintain the interior temperature. However, a variable speed compressor (VSC) must be used to control the thermophysical characteristics, which dramatically alter the temperature with a small pressure change. In this case, fuzzy rules of the sort developed by Mamdani are used to build up the system. The programming platforms utilised to implement the model include MATLAB, SIMULINK, and Fuzzy Logic Toolbox (FLT). The efficiency of fuzzy logic controller design membership will be compared to ensure that the refrigerator temperature is more accurate and until it achieves the best performance, maintains a temperature of 5°C, and adapts to its surroundings. From the research done, the membership 2 with load shows the near accurate temperature of 5°C with steady-state error ±1.97°C.
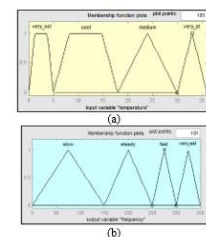

Fig.6. Membership 2 of Fuzzy Controller

OS32-7 Automatic Dry Waste Classification for Recycling Purpose

Muhammad Nuzul Naim Baharuddin[1], Hasan Mehmood Khan[1], Norrima Mokhtar[1], Heshalini Rajagopal[2],
Tarmizi Adam[3], Wan Amirul Wan Mahiyiddin[1], Jafferi Jamaluddin[4]
([1]Universiti Malaya, Malaysia). ([2]Manipal International University, Malaysia),
([3]Universiti Teknologi Malaysia, Malaysia), (UMPEDAC Universiti Malaya, Malaysia)

There has been a serious increment in solid waste in the past decades due to rapid urbanization and industrialization. Therefore, it becomes a big issue and challenges which need to have a great concern, as accumulation of solid waste would result in environmental pollution. Recycling is a method which has been prominent to deal with the problems, as it is assumed to be economically and environmentally beneficial. It is important to have a wide number of intelligent waste management system and several methods to overcome this challenge. This paper explores the application of image processing techniques in recyclable variety type of dry waste. An automated vision-based recognition system is modelled on image analysis which involves image acquisition, feature extraction, and classification. In this study, an intelligent waste material classification system is proposed to extract 11 features from each dry waste image. There are 4 classifiers, Quadratic Support Vector Machine, Cubic Support Vector Machine, Fine K-Nearest Neighbor and Weighted K-Nearest Neighbor, were used to classify the waste into different type such as bottle, box, crumble, flat, cup, food container and tin. A Cubic Support Vector Machine (C-SVM) classifier led to promising results with accuracy of training and testing, 83.3% and 81.43%, respectively. The performance of C-SVM classifier is considerably good which provides consistent performance and faster computation time. Further classification process is improved by utilization of Speeded-Up Robust Features (SURF) method with some limitations such as longer response and computation time.
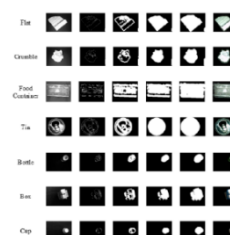
OS32-8 A Low Cost Smart Parcel Box System with Enhanced Security

Ahmad Luqmanulhakim, Wan Norsyafizan W.Muhamad, Suzi Seroja Sarnin, Meor Mohd Azreen Meor
Hamzah ([1]Universiti Teknologi MARA, Malaysia)

A global pandemic of covid-19 has hastened the growth of online shopping or E-commerce. Nowadays, E-commerce transactions provide various products from luxury goods and services to everyday necessities. While the popularity of online shopping has grown fast, there are several common issues that shoppers experience. Common problems that customers experienced are failed delivery, missing parcels and even the criminal case. Malaysia has introduced Pos Laju Ezi Box Kiosk, but still contemporary Kiosk type approach for the delivery system has some problems such as high initial installation cost, the expense of management system and especially security weaknesses in the wireless communication. To overcome the aforementioned problems, this paper proposes a low-cost smart parcel box system that will be installed at individual homes with enhanced security. This system used Arduino Mega 2560 to control all the processes of the developed system. The system will be initiated when couriers send the parcel's tracking number as a message to the user via applications to get the password. For security purpose, password will be provided once the courier's message is the same as the message specified by the user. Couriers then can enter the password provided and insert the parcel into the smart parcel box. The proposed low-cost smart parcel box system ensures that parcels are delivered safely and securely to the customer's door.
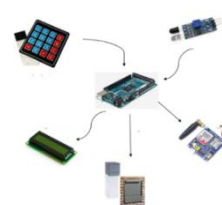
OS32-9 Classification of Body Mass Index Based Face Images Using Facial Landmarks Approach and PCA plus LDA

Hasimah Ali[1], Ho Yong Kang[1], Wan Khairunizam Wan Ahmad[1], Mohamed Elshaikh[1], Norrima Mokhtar[2]
([1]Universiti Malaysia Perlis, [2]Universiti Malaya, Malaysia)

Human faces contain rich information. Recent studies found that facial features have relation with human weight or body mass index (BMI). Decoding "facial information" from the face in predicting the BMI could be linked to the various health marker. This paper proposed the classification of body mass index (BMI) using facial landmark approach based on facial images. In this framework, Discriminative Response Map Fitting (DRMF) method has been used as feature extraction technique to detect and locate the facial landmark points on the facial images. About sixty-six (66) facial landmark points were identified. Only nineteen (19) of facial landmark points have been employed to extract the facial features in terms of distance and ratio features. A total of 221 facial landmark features were obtained and used as feature vector to classify the BMI classes. The rationale of using 221 facial landmark features is because these features were able to exhibit the unique characteristic of the BMI classes, which are normal, overweight and obese. Then, the extracted features were further reduced using Principal Component Analysis (PCA) plus Linear Discriminant Analysis (LDA) to map high dimension features into low dimensional feature with maximize between class scatter and minimize within class variations. Later, the reduced features were subjected to k-NN classifiers. A series of experiments has been conducted on MORPH II database using the reduced facial landmark features to classify the three BMI classes. Based on the experimental results, it shows that the reduced features using PCA plus LDA based on k-NN classifier has achieve the highest recognition rate with accuracy of 83.33 %. The obtained results show that the reduced facial landmark features were able to discriminate the three BMI classes of normal, overweight and obese, thus shows the promising results
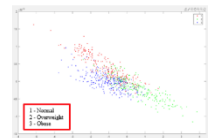
OS33 Signal Processing and Chaotic System (5)
Chair Huailin Zhao (Shanghai Institute of Technology, China)
Co-Chair Fengzhin Dai (Tianjin University of Science and technology, China)

OS33-1 A Visual Measurement Algorithm of Approaching Vehicle Speed Based on Deep Learning

Yurong Zhu, Huailin Zhao, Liu Junjie, Zhang Jinping, Ji Xiaojun (Shanghai Institute of Technology, China)

With the urbanizational process expediting and the national economy developing rapidly and healthily, the amount of private cars is on the rise, and traffic accidents occur frequently due to speeding and other reasons, and the difficulty of traffic supervision has also increased. This topic will use semantic segmentation and feature extraction and matching. Based on the video data of the traffic surveillance camera, an algorithm is designed to quickly calculate the matching of feature points in adjacent frames with low computing power to achieve the calculation. The same vehicle moves within the two frames of the target, so as to calculate the speed of the vehicle. Firstly, performing semantic segmentation based on deep learning, we choose a fully convolutional network to achieve semantic segmentation of depth maps, and distinguish the picture's principal part. After that, we can realize features extraction and mapping. The HOG algorithm is used on the matching step, the target's relative movement is calculated based on these matched point pairs to measure the moving speed of the vehicle. The experiment and the test prove that the system can realize the efficient speed measurement of moving vehicles.
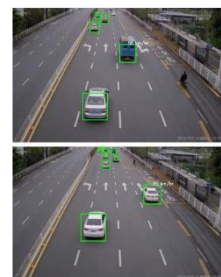
OS33-2 Target Search Based on Scene Priors

Shengyang Lu, Lanjun Liang, Huailin Zhao, Fangbo Zhou, Feng yao
(Shanghai Institute of Technology, China)

Aiming at the problems of reinforcement learning algorithm in target search tasks, such as low accuracy and low fault tolerance, this article mainly introduces a method of reinforcement learning target search based on scene prior in simulation environment. This method mainly uses graph convolutional neural network to extract the current object relationship as the input of prior knowledge. Secondly, it uses the actor-critic algorithm to take the agent's vision, position and prior knowledge as input to decide the agent's next navigation. Finally, use path planning to navigate to the target point to find the target. Through experiments conducted in Habitat and compared with the previous algorithm, the experiment shows that this method is better than the previous algorithm in target search accuracy and navigation efficiency.

OS33-3 A Generalized Hamiltonian Conservative Systems with Multi-scroll Chaotic Flows
Jingwen Liu, Zhonggao Chen (Tianjin University of Science and Technology, China)

By analyzing mechanics and energy of a three-dimensional volume conservative chaotic system proposed by Vaidyanathan and Volos, a new generalized conservative chaotic system with multi-scroll chaotic flows is found based on the corresponding Hamiltonian energy. The new system satisfies both volume conservation and energy conservation. By analyzing the equilibrium characteristics of the system, equilibrium points of the new system are found to be a line. In addition, the number of scrolls of conservative chaotic flows of the new system depend on the corresponding Hamiltonian energy. The paper provides a new conservative chaotic model for chaos application.
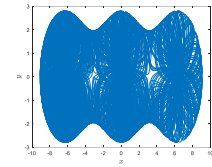
OS33-4 Multi-stability and FPGA Implementation of a Conservative Chaotic System
Minghan Song (Tianjin University of Science and Technology, China)

The paper first studies the reason why a three-dimensional volume conservative chaotic system proposed by Vaidyanathan and Volos can generate chaos by analyzing mechanics and energy. Then, based on numerical methods including balance characteristics, Lyapunov exponents, bifurcation diagrams, phase trajectories and so on, multi-stability of the three-dimensional volume conservative chaotic system are discovered. In addition, the three-dimensional volume conservative chaotic system is realized by using FPGA, and all the results from FPGA implementation are consistent with those from numerical analysis. Which further verify multi-stability of the three-dimensional conservative chaotic system from physical characteristics.
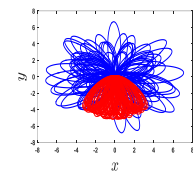
OS33-5 A New Hyperchaotic Financial System
Lei Gong (Tianjin University of Science and Technology, China)

In this paper, a new hyperchaotic financial system is obtained based on a financial system. It is first transformed into Kolmogorov model, which is composed of conservative torque, dissipative torque and external torque, to study the reason why the new system can generate chaos. Then, by studying energy exchange and combining different torques, dynamics of the new system is analyzed, the external torque is found to be the main reason the new system generate chaos. The paper provides a new method of analyzing chaotic dynamics in financial system, and further promotes new strategies are found to control chaos in financial market.
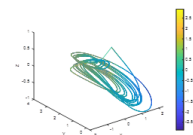
OS34 Robotics Navigation and Control (3)
Chair Jiwu Wang (Beijing Jiaotong University, China)
Co-Chair Shilong Zhen (Beijing Jiaotong University, China)

OS34-1 Research on Path Planning Algorithms of Multiple Mobile Robots in Intelligent Warehousing

Jiwu Wang, Shilong Zheng (Beijing Jiaotong University, China)

In recent years, with the rapid development of the e-commerce industry and the increasing number of orders for commodities, the demand for intelligent automated warehousing systems has become more and more urgent. Therefore, the study of intelligent storage systems based on multiple mobile robots has proved to be a hot spot and development direction of the intelligent manufacturing industry. Among them, the collaborative path planning between multiple mobile robots has become a key issue to be solved urgently. In order to solve this problem, this paper will propose an improved A* algorithm based on the reservation table to solve the collision and traffic jams between robots and realize multi-robot collaborative path planning. The effectiveness of the algorithm is verified by simulation.

OS34-2 Research on the effectiveness of improved ORB depth estimation in monocular vision slam

Jiwu Wang, Weipeng Wan (Beijing Jiaotong University, China)

The application of monocular vision to measure the depth information of image feature points is one of the key points of monocular vision slam.Triangulation is often used for monocular vision to measure the depth information of image feature points, but in actual applications, the uncertainty of feature point matching will cause greater depth uncertainty.This article mainly optimizes the extraction and matching of ORB feature points, improves the key point extraction strategy in ORB, combines quad-tree and RANSAC to complete the feature point extraction and matching of the image, and then uses the final matching result to estimate the depth.Experiments show that the improved feature point extraction and matching technology can effectively improve the depth estimation accuracy.
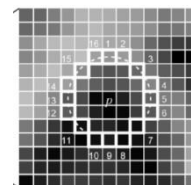
OS34-3 Research on Research on Corner Detection Algorithm Based on Edge Contour in Automatic Loading Positioning

Jiwu Wang, Junwei Fu (Beijing Jiaotong University, China)

At present, automatic loading machines generally have problems such as low efficiency and low degree of flexibility. In the loading process, the use of visual methods to accurately position the cargo platform is one of the key links to improve loading automation. In the actual application process, The corner detection has the problems of low positioning accuracy, high false detection and high missed detection rate. This paper proposes a corner detection method based on the edge contour, and performs the corner detection algorithm. Optimize to improve the false detection rate and missed detection rate in the detection process, and obtain the required corner information. Experiments show that this method can effectively improve the accuracy of corner detection in the positioning link.

GS1 Control System Applications (6)
Chair Hiroaki Wagatsuma ([1]Kyushu Institute of Technology, [2]RIKEN CBS, Japan)

GS1-1 Design of local linear models using Self tuning Control System for PID Tuning According to error

Shinichi Imai (Tokyo gakugei university, Japan)

PID control is widely used in process systems represented by chemical processes and petroleum refining processes. The reason is that PID control has a simple structure. However, most of the existing systems are non-linear systems, and it is difficult to always obtain good control results with fixed PID control. Therefore, in this study, we propose a method of tuning the PID gain according to the deviation (control error) of the control result, and verify the effectiveness of this method through experiments. For self-tuning PID control using a local linear model, we propose a program that performs PID tuning only when the deviation occurs with a certain magnitude. A simulation is performed on the Hammerstein model, which is a non-linear system. As a result of the experiment, the number of PID gain changes could be significantly reduced.
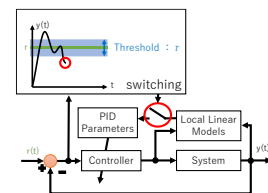
GS1-2 A Systematic Analysis of the Knee Support Exoskeleton Based on Multibody Dynamics Toward Personalization with 3D Printed Spring-Damper Components

Shintaro Kasai[1], Pancho Dachikinov[1], Kohei Tanaka[1], Hiroaki Wagatsuma[1,2]
([1]Kyushu Institute of Technology, Japan; [2]RIKEN CBS, Japan)

Exoskeleton-type assistive devices have been studied a long time focusing on the universal design and a simplification for mass production, and recently the concept is extended to the personalization according to the advancement of 3D printing, which allows to embed spring-damper systems in the form of compliant mechanisms. Therefore, a sophisticated kinematic and kinetic analysis is highly important for the realization of integrative systems and theories of multibody dynamics enhance the capability to find best parameters that are suitable for target body requirements. We analyzed a knee support exoskeleton in the form of the linkage system as the rigid-body dynamics and estimated necessary spring-damper components in the system to reduce burden on joint motions, especially persons with joint dysfunctions.

GS1-3 A Drone-Based Concrete Crack Inspection System by Using Morphological Component Analysis and Sub-Pixel Width Estimation

Ankur Dixit[1], Wataru Oshiumi[1], Hiroaki Wagatsuma[1,2]
([1]Kyushu Institute of Technology, Japan; [2]RIKEN CBS, Japan)

Social infrastructure inspections were relying on human experts, and then a recent topic is a possible implementation to realize an automated inspection based on machines and sophisticated software algorithms. We have studied an advancement of Morphological Component Analysis (MCA) to apply the concrete-crack position estimation especially for submillimeter-width cracks, which are highly difficult for traditional methods to detect finely. We demonstrated a concrete crack detection from images obtained from proximity cameras attached a specialized multi-copter, by using the MCA-based crack position estimation and the linear regression-based sub-pixel width estimation. It will contribute to the actual field work not only for the concrete crack detection but also various social infrastructure inspections.
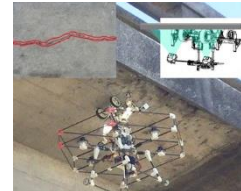
GS1-4 A Systematic Geometric Design Method of Flexible Bars Available for Personalized Knee Orthoses with Spring-Damper Functions

Pancho Dachikinov[1], Shintaro Kasai[1], Kohei Tanaka[1], Hiroaki Wagatsuma[1,2]
([1]Kyushu Institute of Technology, Japan; [2]RIKEN CBS, Japan)

3D printed compliant mechanisms were recently highlighted not only in the traditional way, but also in the reverse engineering of human joint supportive devices. However, a systematic design principle is unclear for solving of the issue how it can be modifiable to fit to target body requirements in the sense of the personalization. We proposed a geometrical approach providing the target design by using a morphological replacement at the concentration of stress. This concept can be verified in orthoses to improve the knee joint function by 3D printed flexible prototypes. It allows larger deformations of the bars to control joint's motion. Theoretical analysis and experiments demonstrate the flexibility and support during the flexion and extension of the knee. It implies the impact of the geometry in orthosis designs.

GS1-5 State-space modeling of fingers motion measured by the Leap Motion Controller

Ryuichi Usami, Hideyuki Tanaka (Hiroshima University, Japan)

This paper studies modeling of the motion of experts in a sport to demonstrate their motion to beginners. It deals with the dynamics of transient response from one position to another, such as a crouching start of a short-distance race. A modeling algorithm is developed to remove personal habits of experts from their motion and to present simple models to learners according to their learning stages. The algorithm is based on a step response of a state-space representation and the deterministic realization theory. It is applied to fingers motion captured by the Leap Motion Controller, and simplified models are obtained by reducing the order of the state-space representation.
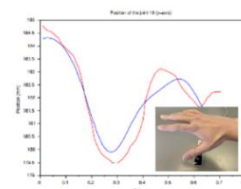
GS1-6 Applicability Verification of iWakka Game to Children with Developmental Coordination Disorder

Masakazu Nomura[1], Moe Nishiya[1], Yoshifumi Morita[1], Hideo Yamagiwa[2]
([1]Nagoya Institute of Technology, Japan) ([2]Tokyo Metropolitan Tobu Medical Center, Japan)

In our previous study, we developed a testing and training device of adjustability for grasping force "iWakka". Moreover, we developed "iWakka Game" including software for autistic patients by improving the game quality of the original one. In this paper, we investigated the applicability of iWakka Game to children with developmental coordination disorder (DCD). Based on the results of the preliminary experiment, we developed a small-size grasping body "Wakka" and improved the evaluation method for children with DCD. We applied iWakka Game to 4 children aged 5 to 9 years with DCD. As a result, all the children could complete the evaluation task with iWakka Game. The proposed evaluation method made it possible to extract the characteristics of hand dexterity.

GS2 Learning Methods (5)
Chair Masato Nagayoshi (Niigata College of Nursing, Japan)

GS2-1 A basic study of how to exchange work shifts using reinforcement learning on a constructive nurse scheduling system

Masato Nagayoshi (Niigata College of Nursing, Japan), Hisashi Tamaki (Kobe University, Japan)

Various studies have been conducted on the nurse scheduling problem, which is the creation of a work schedule for nurses. However, for practical use, adjustments including various constraints and evaluation values are required, and the created work schedule is often not practical as it is, so many head nurses still feel burdened by creating work schedules. In this paper, we propose a work revision method using reinforcement learning for a constructive nurse scheduling system. The constructive nurse scheduling system has the characteristic of having easy to understand shift schedule creation procedures and rules because the system does not use the evaluation value for the entire shift schedule. We have confirmed the possibility of improving the quality of the shift schedule by the proposed method.
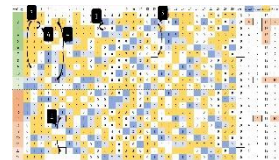
GS2-2 Developing Machine Learning and Deep Learning Models for Customer Churn Prediction in Telecomunication Industry

Teoh Jay Shen, Abdul Samad Shibghatullah (UCSI University, Malaysia)

Customer churn is always a significant problem and one of the biggest concerns of telecommunication companies. The companies are attempting to create and design an approach to predict customer churn. This is why determining factors that causes the customer to churn is significant. The proposed models constructed in this work apply both the machine learning and deep learning algorithms. Those models was constructed and run under the Python environment and it used an open sources dataset that are available to everyone on www.kaggle.com. This dataset contained 7043 rows of customer's data with 21 features, and it was applied in the training and testing process of the models development. These models used four different types of machine learning and deep learning algorithms, which are the Artificial Neural Network, Self-Organizing Map, Decision Tree and a hybrid model with the combination of the Self-Organizing Map and Artificial Neural network algorithms.

GS2-3 Liver Segmentation in CT Images Using Deep-Learning and 3D CRF

Shuntaro Nagano[1], Guangxu Li[2], Tohru Kamiya[1]
([1]Kyushu Institute of Technology, Japan), ([2]Tiangong University, Tianjin, China)

In recent years, the development of CAD systems aimed at reducing the burden on doctors and improving diagnostic accuracy has been promoted. In this paper, we propose a segmentation method for the liver site on abdominal CT images as a pretreatment for a CAD system using Dynamic CT images. The method consists of two stages. First, we segment the liver with a model based on U-net, a segmentation model using CNN. Next, the 3D CRF (Conditional Random Field) is used to make corrections that take into account the three-dimensional characteristics of the liver to improve the accuracy of segmentation. In the experiment, the accuracy was evaluated for CT images of 20 cases.
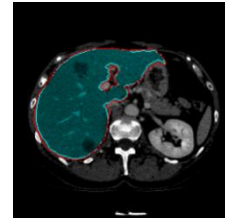
GS2-4 Judgement on Shunt Sounds from Vascular Access using YOLO Deep Learning Model

[1]Kyosuke Fujiwara, [1]Takayuki Yamamoto, [1]Lindsey Tate, [2]Kazuya Kibune, [1]Hiroki Tamura
([1]University of Miyazaki, Japan). ([2]Tokatsu Dialysis Hospital & Clinics, Japan)

A shunt is a blood vessel that connects a vein directly to an artery to allow a large volume of blood to pass through for hemodialysis. The sound of a shunt is the sound made at the junction. There is a risk of stenosis or blood clots in the shunt. The test is usually done by a doctor using an echo. However, an echocardiogram can only be performed with a special machine. Therefore, we thought that we could link the results of the echocardiography to the shunt sound and use machine learning to accurately diagnose the shunt as long as we had the shunt sound data and a computer. We used the wavelet transform to image the shunt sounds before and after stress, and trained YOLOv2tiny to classify the images with the labels "abnormal," "gray(uncertain)," and "normal. In this case, YOLOv2tiny alone did not improve the discrimination rate. Therefore, we tried to improve the discrimination rate by performing multivariate analysis using the multivariate calculated in the judgment of YOLOv2tiny. In this paper, we compared the discrimination rate of the result of YOLOv2tiny alone and the result of the combination of YOLOv2tiny and multivariate analysis, and explain how to achieve a higher discrimination rate.
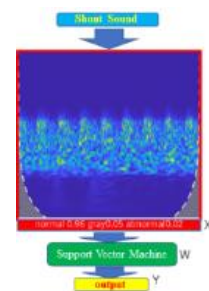
GS2-5 Research of Classification of Palmprint Based on Deep Learning

Kunyu Yu, Hiroshi Matsuki (Ashikaga University, Japan)

After many years of clinical research in traditional Chinese medicine, it was found that the large thenar part of the palm was related to allergic reactions such as the asthma. This paper classifies the thenar part of the palm according to the characteristics of the wrinkles through the transfer learning in the depth learning, so as to play an assistant role in the diagnosis. The palmprint of the thenar palm can be divided into two categories (positive and negative). In this paper, the palm data collected will be preprocessed to intercept the large thenar part. The classification is mainly based on the deep learning convolution neural network, using the TensorFlow framework and inception V3 model. Simulation results show that the inception V3 model recognition algorithm has high accuracy in the classification of negative and positive palmprints.

GS3 Robotics (3)
Chair Hideyuki Tanaka (Hiroshima University, Japan)

GS3-1 A Three-Dimensional Design of the Multi-material Joint System to Realize a Structural Spring-Damper Compliant Mechanism with Versatility in Engineering Fields
Pancho Dachkinov[1], Anirudha Bhattacharjee[2], Bishakh Bhattacharya[2], Hiroaki Wagatsuma[1,3]
([1]Kyushu Institute of Technology, Japan; [2]Indian Institute of Technology Kanpur, India; [3]RIKEN CBS, Japan)

Design of a 3D printed cross-spring compliant joint is an emerging topic for its multipurpose applications in various fields due to its realization from a combination of flexible materials with different mechanical properties. It performs the motion by deformation in the elastic region and is suitable for precision engineering applications and instruments. The proposed concept is a modification of a traditional cross-spring pivot, which effectively provides frictionless and wear free in-plane motion. The joint's behavior is analyzed based on a non-linear FEA simulation and the properties were investigated with various loading conditions. Compliant joints are envisaged to bring paradigm shift in the design of high-precision actuators and robotic manipulators.
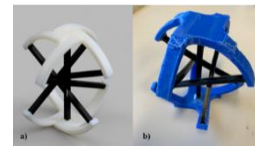
GS3-2 Haptic Device that Presents Sensation Corresponding to Palm on Back of Hand for Teleoperation of Robot Hand Report 5: Verification of development device specifications
Kyosuke Ushimaru, Noritaka Sato (Nagoya Institute of Technology, Japan)

Recently, research and development of disaster response robots gained momentum. However, it is known that teleoperation of a robot hand equipped on a rescue robot is difficult. So, in this research, we propose and develop a new tactile presentation device for tele-operation of a robot hand. Proposed device is presented the tactile sensation on the back of the operator's hand. The required parameters for device development, Interval between stimulus points(i), Diameter of the stimulus point(d), Force of the stimulus point(f), were determined by subject experiments. The device was developed based on the optimized values (i, d, f) = (30mm, 6mm, 0.9kgf). A suction stimulus was used as the stimulus presentation. In this paper, we confirm that the developed device can present tactile sensation correctly and discuss the results.

GS3-3 HBV Epidemic Control Using Time-Varying Sliding Mode Control Method

Arsit Boonyaprapasorn[1]. Suwat Kuntanapreeda[2], Parinya Sa Ngaimsunthorn[2],
Thunyaseth Sethaput[3], Tinnakorn Kumsaen[4]
([1]Chulachomklao Royal Military Academy, Thailand)
([2]King Mongkut's University of Technology North Bangkok, Thailand)
([3]Thammasat University, Thailand) ([4]Khon Kaen University, Thailand)

Hepatitis-B (HBV) disease is one of the life-threatening diseases due to causing cirrhosis and liver cancer in the infected person. Setting the policy to control the HBV epidemic is an important issue that can be achieved by using feedback controller design procedure through the compartment mathematical model. In this article, the sliding mode controller with a time-varying sliding surface was employed to set the multiple measures control policy for controlling the HBV epidemic. The stability of the control HBV epidemic system was investigated. The simulation of the control system was conducted to confirm the feasibility of applying the time-varying sliding mode controller for setting the HBV control policy. The simulation results showed that the designed control policy can drive the target subpopulation to the desired levels. Thus, the time-varying sliding mode controller is a feasible approach to set the measures for controlling the HBV epidemic.
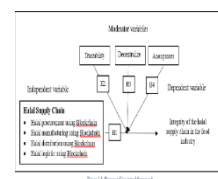
GS4 Applications (3)
Chair Noritaka Sato (Nagoya Institute of Technology, Japan)

GS4-1 Blockchain Technology for Halal Supply Chain Management

Kadeer Zulihuma, Abdul Samad Shibghatullah, Chit Su Mon
(Institute of Computer Science & Digital Innovation, UCSI University, Malaysia)

Blockchain technology (BT) is a distributed and decentralized database that store transaction information in a network. Due to providing better visibility and transparency, this technology has gained a considerable attention in the recent years. This research is carried out with the purpose of exploring the potential of blockchain technology to increase supply chain integrity in halal food industry. Three features of smart contract including traceability, decentralized, and anonymity are added to the model as moderators to explore their influence on integrity of halal supply chain. According to the survey of 251 halal supply chain practitioners in Kuala Lumpur, the proposed model was tested. The results demonstrated that BT has a positive and significant direct effect on integrity of halal supply chain, and traceability has a significantly positive influence on integrity of halal supply chain. However, decentralization and anonymity have insignificant effect on integrity of supply chain.

GS4-2 Smart Tourism Guide Application Using Location-Based Services – Go.Travel
Wong Yit Meng, Abdul Samad Bin Shibghatullah, Kasthuri Subaramaniam (UCSI University, Malaysia)

Smart tourism technology is rapidly advancing, opening new prospects for tourism, and providing higher-quality, all-around travel services to the general population. This research paper presents the creation of an assistive application that allows travellers to use tourism-related services in Malaysia to improve their travel experience. The objective of this project is to develop and enhance a Smart Tourism Guide Application, Go.Travel based on the limitations discovered. Tourists can use the proposed application to view nearby destinations, get information about them, view nearby places in Google Maps, share their stories in travel forum, read the latest articles, and save their favourite spots. This project uses an iterative development strategy. Android Studio was utilized extensively for development. It is best hoped that tourists will be able to travel more efficiently and effectively in Malaysia with the use
of the proposed application.
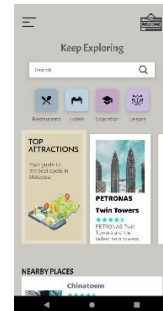
GS4-3 Gesturenomy: Touchless Restaurant Menu Using Hand Gesture Recognition
Ian Christian Susanto, Kasthuri Subaramaniam, Abdul Samad Bin Shibghatullah (UCSI University, Malaysia)

Hand gesture recognition is one of the more modern methods of human-computer interaction. However, study of its application in real world setting is sparse, especially its use in digital restaurant menus. We discuss various types of computer vision-based hand gesture recognition and decide on hand pose estimation as the method of recognition used. An analysis into the requirements show that respondents are concerned with the hygiene of touchscreen digital menus. We provide a description of the system being developed. The system passes the user acceptance tests given. This project contributes to the knowledge base by providing one case study of the use in hand gesture recognition in digital restaurant menus, as research in this application of gesture recognition is currently minimal. The authors hope that this project can open the doors for more research into this area.

N-1 Compact Ultra-Wideband Slotted Microstrip Patch Antenna for 5G, IoT and RFID Applications

Gurney Nga, Mastaneh Moakyef, Shahid Manzoor, Manickam Ramasamy (UCSI University, Malaysia)

With new emerging technologies in 5G era, the need of compact and cost-effective antenna holds significant promise for delivering contributions to society. The compact UWB omnidirectional microstrip patch antenna of 36mm × 32mm × 1.6mm for IoT, 5G and RFID applications is proposed and simulated. The proposed antenna covers frequency of 5.1256 GHz to 6.4391 GHz with UWB (bandwidth > 500MHz) characteristics. The proposed antenna has an FR4 substrate that made the antenna a cost-effective candidate in 5G era. The directivity of 5.3 dBi with gain of 3.51 dBi are obtained from the simulation results.
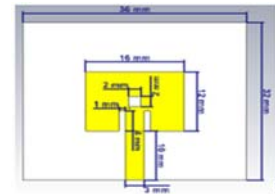
N-2 Drone Performance Analysis Based on SNR Factor

Gershom Phiri, Mastaneh Moakyef, Sew Sun Tiang, Wong Chin Hong (UCSI University, Malaysia)

In this paper, a depth analysis of a drone performance based on the signal to noise ratio (SNR), has been provided. The MATLAB software is used to simulate the effect of frequency, power and distance on the performance of drones. The SNR optimization has been proposed as well. The light has been shed on the drone performance in wildfire scenario.

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