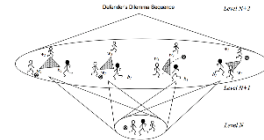


## PS abstracts

### PS-1 Dynamic Structures for Evolving Tactics and Strategies in Team Robotics

Jeffrey Johnson, Ruggero Rossi (The Open University, UK)

The autonomous robot systems of the future will be teams of robots with complementary specialisms. At any instant robot interactions determine relational structures, and sequences of these structures describe the team dynamics as trajectories through space and time. These structures can be represented in algebraic forms that are realizable as dynamic multilevel data structures within individual robots, as the basis of emergent team data structures. Such formalisms are necessary for robots to learn new individual and collective behaviours. The theory is illustrated by the example of robot soccer where robot interactions create structures and trajectories essential to the evolution of new tactics and strategies in a changing environment.



### PS-2 EU-Way Development - Effective and Rational Development Way -

Masato (Max) Nakagawa (Executive Fellow, DENSO CORPORATION, Japan)

In this Plenary Speech will cover three elements describe as follows; Firstly, “Factory-IoT” technology which is DENSO company manufacturing strategy globally. Secondly, collaboration between Germany and Japan in terms of innovation. Thirdly, EU-Way development which is effective and rational manner of development. From his working experience in Germany, United Kingdom and the Netherlands in consecutive 14 years, EU-Way development will be explained. One of the key points is that they make “Competition Field” and “Non-Competition Field” in their technical domains. In the “Non-Competition Field” which is also called a “Cooperative Field”, they cooperate together in the same industry sector to create common specification or to establish the standardization so that they can concentrate on differentiated technology as a “Competition Field” This approach is one of their driving forces for development and innovation.

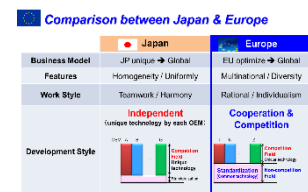


Fig. Development Style Comparison between Japan and Germany

### PS-3 Innovation on Manufacturing Generated by Intelligent Technologies

Ken-ichi Tanaka, Haruhisa Okuda (Mitsubishi Electric Corporation, Japan)

In order to cope with social problems such as labor population decrease, the autonomous cell production robot system had been developed to realize automation in variable variety multi production. The intelligent technologies such as random bin picking, force control, and error recovery were developed to apply the robot from simple-transport-work to assemble-task. In addition to the talk about such technologies, it will also be described that open innovation method cooperating with universities to create research results which our company would not achieve independently. The examples of the latest robot technology development using artificial intelligence will also be described.



## IS abstracts

### IS-1 Modular Playware and Personal Health Technology

Henrik Hautop Lund (Technical University of Denmark, Denmark)

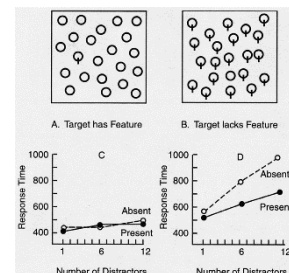
In this paper, we describe the development of personal health technology such as wearable systems monitoring health conditions. It has been advocated that such personal health technology through monitoring health status may motivate people to perform health related actions and life-style changes. Here we describe a methodology on how these personal health technologies may rather be used as a tool for designing and adapting game activities, which motivate people to perform the desired actions. Especially, we exemplify this methodology with the use of FitBit monitoring of steps and heart rate to the design of appropriate, physically demanding games for the modular interactive tiles, Moto Tiles, which are used by older adults for prevention and rehabilitation. Thereby, the motivation to perform the actions arrives from the fun play on the Moto Tiles, whereas the personal health technology is used as a tool to monitor the effect and guide the game development.



### IS-2 How new technologies might lead to a paradigm shift in psychological and neuropsychological research

Luigi Pagliarini, Henrik Hautop Lund (Technical University of Denmark, Denmark)

Recently, we started to apply old psychological and neuropsychological standard tests and therapeutic exercises into a different domain of technology. Therefore, while maintaining the whole conceptual and logical structure of the traditional approach – i.e. tests mostly made by hand on paper or with the mouse and computers' screens - intact, we moved them onto the physical interactive and playful technology, Moto Tiles. Such a translation of input/output, likewise involving dissimilar perceptions and different parts of our motor system (i.e. legs, feet and balance system), might imply a change in subjects' mental and behavioural strategies, variations in efficacy and efficiency, as well as a redefinition of reaction times. In short, this shift, besides providing a significant extra tool to older practices, might work as a crucial test for all of the existing theoretical background, too. We describe our new method and report few of the first empirical applications.



### IS-3 Natural Computing Paradigm – A Concise Introduction

Takashi Yokomori (Waseda University, Japan)

Natural computing (NC) is an emerging area of research that investigates computing techniques and models inspired by nature on one hand, and it also investigates phenomena taking place in nature in terms of computational methodologies on the other hand. Thus, research in NC congenitally has interdisciplinary flavor, which bridges between computer science and various disciplines of natural science. Because of its interdisciplinary nature, NC connects and covers a broad spectrum of fundamental research fields including biology, chemistry, physics, medical science, and so forth. In this article, we give a concise introduction to the new computing paradigm of NC. Specifically, we give an overview of selected topics of the fields from theory to experiments, where the stress is primarily put on theoretical achievements in computing paradigms called molecular computing and chemical reaction computing.

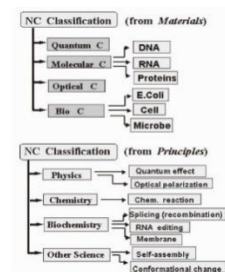
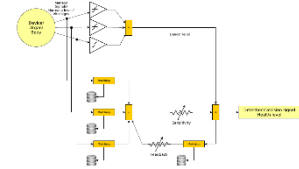


Figure 1. Natural Computing Paradigms Inspired by Nature (A part)

## IS-4 Artificial Immune Ecosystems: challenges for a new generation of bio-inspired secure and resilient systems

Pierre Parrend  
(ECAM Strasbourg-Europe, France)

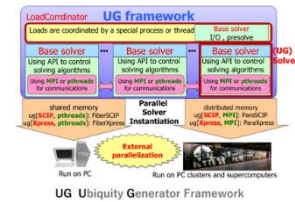
The rapid evolution of IT ecosystems significantly challenges the security models our infrastructures rely on. Beyond the old dichotomy between open and closed systems, it is now necessary to handle securely the interaction between heterogeneous devices building dynamic ecosystems. To this regard, bio-inspired approaches provide a rich set of conceptual tools, but have failed to lay the basis for robust and efficient solutions. Our research effort intends to revisit the contribution of artificial immune system research to bring immune properties: security, resilience, distribution, memory, into IT infrastructures. We introduce the concept of artificial immune ecosystems, which encompass a comprehensive immune protocol, libraries for detection and investigation of anomalies, and an underlying middleware layer, for bringing immunity to IT infrastructures, the Cloud, and IoT environment.



## IS-5 Harnessing over a Million CPU Cores to Solve a Single Hard Mixed Integer Programming Problem on a Supercomputer

Yuji Shinano (Zuse Institute Berlin, Germany)

The performance of mixed integer programming (MIP) solvers has improved tremendously in the last two decades and these solvers have been used to solve many real-world problems. ParaSCIP is the most successful parallel MIP solver in terms of solving previously unsolvable instances from the well-known benchmark instance set MIPLIB by using supercomputers. ParaSCIP has been developed by using the Ubiquity Generator (UG) framework, which is a general software package to parallelize any state-of-the-art branch-and-bound based solvers. ParaSCIP is a parallelized MIP solver of a single thread solver SCIP. Since Xpress is a multi-threaded solver and ParaSCIP can run at least 80,000 processes in parallel for solving a single MIP, ParaXpress could handle over a million CPU cores. In this talk, a ground design of the UG framework and its latest extensions to harness over a million CPU cores will be presented and preliminary computational results will be provided.



## IS-6 Trust of Virtual Agent in Multi Actor Interactions

H. M. Khalid, W. S. Liew, B.S. Voong, M.G. Helander (Damai Sciences, Malaysia)

Trust is crucial when integrating virtual agents in human teams. Our study investigated the combined use of subjective (general trust, psychological) and objective (physiological) measures in predicting human trust of agents undertaking social tasks. The subjective measures comprised twelve self-report trust scores on ability, benevolence and integrity (ABI). The objective measures included facial expressions, voiced speech, camera-based heart rate and gestural posture. Forty-eight subjects participated in a 2x2x2 within subject design. They interacted with two virtual agents - a male Chinese and a female Malay. Each experimental condition comprised three human subjects (a teleoperator and two clients) and one avatar. The interactive dialog involved a business set up. A neuro-fuzzy algorithm extracted rules from the psychophysiological data to predict trust at low, medium and high trust levels. The results revealed that trust can be predicted with an accuracy of 88%. However, if gestures were excluded, the accuracy increased to 90%.



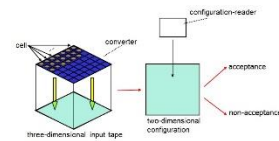
## OS abstracts

### OS1 Computer Science and Information Processing (5)

#### OS1-1 k-Neighborhood Template A-Type Two-Dimensional Bounded Cellular Acceptors

Makoto Sakamoto<sup>1</sup>, Yu-an Zhang<sup>2</sup>, Masamichi Hori<sup>1</sup>, Haruka Tsuboi<sup>1</sup>, Satoshi Ikeda<sup>1</sup>,  
Kenji Aoki<sup>1</sup>, Tsutomu Ito<sup>3</sup>, Takao Ito<sup>3</sup>, Yasuo Uchida<sup>4</sup>, and Tsunehiro Yoshinaga<sup>5</sup>  
(<sup>1</sup>University of Miyazaki, Japan, <sup>2</sup>Qinghai University, China, <sup>3</sup>Hiroshima University, Japan,  
<sup>4</sup>Ube National College of Technology, Japan, <sup>5</sup>Tokuyama College of Technology, Japan)

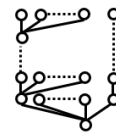
In this paper, we deal with three-dimensional computational model, k-neighborhood template A-type two-dimensional bounded cellular acceptor on three-dimensional tapes, and discuss some properties. This model consists of a pair of a converter and a configuration-reader. The former converts the given three-dimensional tape to two-dimensional configuration. The latter determines whether or not the derived two-dimensional configuration is accepted, and concludes the acceptance or non-acceptance of given three-dimensional tape. We mainly investigate some open problems about k-neighborhood template A-type two-dimensional bounded cellular acceptor on three-dimensional tapes.



#### OS1-2 An efficient structure of organization with complete individual guidance

Mamoru Yoshimura, Tsutomu Ito<sup>1</sup>, Makoto Sakamoto, Takao Ito<sup>1</sup>, Satoshi Ikeda  
(University of Miyazaki, Japan) (<sup>1</sup>Hiroshima University, Japan)

This research clarifies the efficient organizational structure using mathematical model. Previous studies have shown that the structure of an efficient organization is limited under given settings when there is only one criterion to evaluate. In this study, we show that an optimal organizational structure which has not been known until now occurs under the setting different from the previous research.



#### OS1-3 Consideration for the Possibility to the Tourism Support Contents by the Markerless AR Technology

Masamichi Hori, Makoto Sakamoto, Koshiro Mitsuhashi<sup>1</sup>, Yukari Kodama<sup>1</sup>, Takeshi Tanaka,  
Mihoko Fukushima, Chikashi Deguchi, Masahiro Yokomichi, Masayuki Mukunoki,  
Kunihito Yamamori, Atsushi Iiboshi<sup>2</sup>(University of Miyazaki,  
<sup>1</sup>Miyazaki Multimedia Academy, <sup>2</sup>Takachiho Muratabi Co., Ltd., Japan)

Currently, the tourism industry in Miyazaki prefecture has various problems, and various measures are taken. On the other hand, in 2016 virtual technology attracted much attention also on AR technology. We thought that through the AR technology experience, we could aim for an increase in tourists. Therefore, we will create new applications for smartphones using AR technology and aim for tourism support. First, prototype an application with markerless and features for smartphones etc., and conduct experiments. As a result, there was improvement and it was not completed. However, it seemed possible to become an application that realizes tourism support.



## OS1-4 Fundamental study on tourism support using 3DCG

Haruka Tsuboi<sup>1</sup>, Makoto Sakamoto<sup>1</sup>, Masamichi Hori<sup>1</sup>, Yosuke Iriyama<sup>1</sup>, Yuki Kai<sup>1</sup>,  
Hazuki Watanabe<sup>1</sup>, Yu-an Zhang<sup>2</sup>, Atsushi Iboshi<sup>3</sup>, Koshiro Mitsuhashi<sup>4</sup>, Yukari Kodama<sup>4</sup>  
(<sup>1</sup>University of Miyazaki, Japan <sup>2</sup>Qinghai University, China <sup>3</sup>Muratabi, Ltd, Japan,  
<sup>4</sup>Miyazaki Multimedia Academy, Japan)

The penetration rate of CG (computer graphics) in recent years has become remarkable. Currently, there are various examples of utilization such as movies and animation, various simulation and tourism projects, sales visuals and so on. Also, as the Tokyo Olympic Games are held in 2020, the demand for tourism in Japan is getting bigger. Accordingly, we believe that efforts towards tourism support are necessary even in local government units. Therefore, we considered fundamental research of this moment, considering whether we can PR such as we do not exist by using CG technology for the rich nature and sightseeing spot of Miyazaki prefecture where we live. In this research, we focused on "Takachiho-cho", which is known as a land with a connection to "Japanese mythology" among Miyazaki prefecture. As a goal, tourism support such as combining the created 3DCG model with real underwater images and aerial images, introducing rich nature as the main and historic tourist attractions.



## OS1-5 Clustering Analysis Based on Improved Fuzzy C - Means Algorithm

Qiongqiong Hu, Yiyang li, Yong Ge, Yu-an Zhang, Qinglian Ma<sup>1</sup>, Makoto Sakamoto<sup>1</sup>  
(Qinghai University, China, <sup>1</sup>University of Miyazaki, Japan)

Cluster analysis is one of the most important technologies in the field of data mining, and it is also a hot topic in academic research. So far, it has made great achievements in theory and method, and plays an important role in data analysis in various fields. The fuzzy C-means algorithm (FCM) maintains the simplicity of its thinking, the time complexity is close to linear, and it is efficient and scalable for large-scale data mining. Particle Swarm Optimization (PSO) is an optimization tool with global optimization ability, and the group intelligence is formed by the interaction between particles in the group, and the optimal result is found by the intelligence. However, with the deepening of algorithm research, its research prospects and application areas are increasingly bright and compelling.

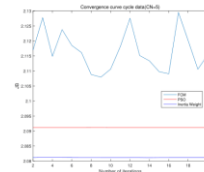


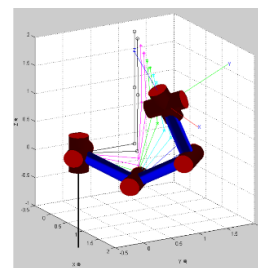
Fig. 1. Under the condition of CN = 5, the fitness value curve under different strategies (FCM represents the fuzzy C-means algorithm, PSO represents the idea of integrating the particle swarm algorithm in FCM, and the Inertia Weight represents the linearly decreasing inertia weight)

## OS2 Intelligent Navigation (6)

### OS2-1 Robot Manipulator Arm Inverse Kinematics Analysis by Jacobian

Sun Oh Park, Min Gyu Jung, Jin Gon Yoon, Min Cheol Lee (Pusan National University, Korea)

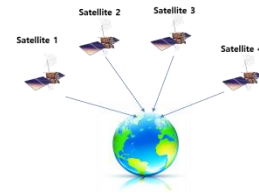
We are publishing the collected abstracts for the ICAROB participants. It will help the participants for guiding them to the interesting session. The abstract, including a text, an illustration, or a chart, must be kept within **10 rows** shown in this template. The abstract consists of the paper title, the author's name(s), the affiliation(s), text and the most impressive one illustration. Time New Roman is required for its font. Please use 12-point for the title, 11-point for your name(s), affiliation and country(s) and 10-point for the text. Do not write or print anything outside the print area. For your convenience, we provide this template to allow you to prepare the abstract with MS-WORD easily. (Times New Roman 10 Point)



## OS2-2 Indoor Position recognition using the pseudo-range estimation

Jongwoo An, Hosun Kang, Jiwook Choi, Jangmyung Lee (Pusan National University, Korea)

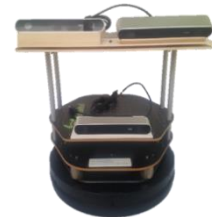
In this paper, we propose a method of position recognition in indoor environment by pseudo range estimation of each satellite. Position recognition is a core technology for operating autonomous intelligent robots such as Unmanned Aerial Vehicle System(UAV), Automated Guided Vehicle(AGV). The Position recognition technology is divided into outdoor position recognition and indoor position recognition. The outdoor position is estimated using Global Positioning System(GPS) and the indoor position is estimated using various sensors such as Beacon and Inertial Measurement Unit(IMU). Due to the development of the technology, outdoor position recognition using GPS can be precise position estimation, but indoor position recognition using various sensors has a cumulative error caused by various factors and it is difficult to operate for a long time. In this paper, to overcome this drawback, we analyze the relationship between the velocity of the moving object and pseudo-range shift each satellite, and estimate the indoor position of the moving object by estimating the pseudo-range.



## OS2-3 Distance measurement algorithm based on the object recognition

Hosun Kang, Nahyun Lee, Jangmyung Lee (Pusan National University, Korea)

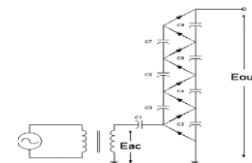
This paper implements an algorithm that recognizes an object using a vision system and measured the distance to the object. Recently, autonomous navigation systems such as UAV and AUV are attracting attention. In order to operate these systems safely, it is necessary to recognize obstacles on the moving path accurately and quickly. Generally, various sensors are used to recognize the surrounding environment. These methods are affected by disturbance caused by the surrounding environment. To overcome these drawbacks, this paper proposes an obstacle recognition algorithm using a stereo camera. For obstacle recognition, disparity is obtained by removing the remaining part of the object except the recognized object from the image in order to improve the computation speed. Finally, after calculating the distance, we confirm the algorithm by comparing with the actual distance.



## OS2-4 An-ion air purifier system using IoT Technology

Heeje Kim, Dohyun Kim (Pusan National University, Korea)

We have developed the an-ion air purifier which can remove various fine dust very efficiently. It was based on the principle of high voltage corona discharge that was fabricated for air cleaning from various fine dust. That is a big issue for human society. The best switching frequency was 10kHz, and the output voltage was approximately 20kV. In order to remove the fine dust, the an-ion air purifier was controlled properly for removing the fine dust by using the Arduino and personal smart-phone app. From these experiments, we could remove various fine dust much more easily and effectively



## OS2-5 Solar Panel Temperature Control System using IoT

Min-soo Kim, Hee-je Kim (Pusan National University, Korea)

Solar photovoltaic systems are renewable energy sources that are used widely around the world. On the other hand, the efficiency decreases as the temperature of the solar panels increases. To prevent this phenomenon, a cooling fan can be installed on the back side of the solar panel to increase the efficiency. The solar system efficiency also decreases due to weather conditions and unexpected situations. To overcome this problem, an IoT (Internet of Things) system was used to monitor the state of the solar system and control the cooling fan. The core microprocessor used in IoT systems was Arduino. Using Arduino, an IoT system can be implemented simply and inexpensively. The entire system was designed and tested and the efficiency increased by approximately 4.7%. Although it is a small 30W capacity photovoltaic system, its efficiency is expected to be increased by applying it to a photovoltaic system of more than 1kW in the near future.



## OS2-6 Enhancement of Mobile Robots Stability and Hardware Based on Reinforcement Learning

Ki-seo Kim, Jeong-hwan Moon, Jang-myung Lee (Pusan National University, Korea)

In this paper, we apply the obstacle avoidance run reinforcement learning algorithm used in the mobile robot using the LiDAR sensor. Q-learning and Deep Learning were applied to reinforcement learning algorithms. We solve the unnatural movements in the deceleration and acceleration of the robot using feedback learning. The results of simulation are applied to actual hardware to show how to increase the safety of driving.



## OS3 New Challenges to Adaptive & Learning Control-1(5)

### OS3-1 A sound-based measurement of sway angle for anti-sway control of overhead crane

Miki Matsunaga, Masayoshi Nakamoto, Toru Yamamoto (Hiroshima University, Japan)

The cranes are well used in field such as transportation of load in construction field, factory and dock. For anti-swing control of overhead crane, a deflection angles must be estimated. But it is difficult to estimate deflection angles directly. Therefore, we show a new measurement method for the deflection angles by using two microphones as angle sensors. The feature of our method is to achieve contact-less sensing, high flexibility of installation, low realization cost, easy to maintenance. The method employs a time delay of arrival (TDOA) of acoustic signals which are picked up by the two microphones. Also, we show an algorithm to obtain the deflection angles from the TDOA by using the Newton's method. Finally, we show experimental results of two patterns (stationary and swaying) to demonstrate the effectiveness of the proposed method.

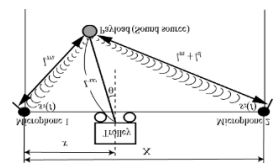
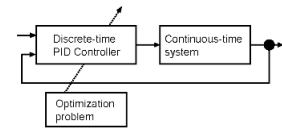


Fig.1. Overhead crane

### OS3-2 Sampled-data PID control system with Sensitivity Function for a Second-order Plus Dead-time System

Ryo Kurokawa, Takao Sato, and Yasuo Konishi (University of Hyogo, Japan)  
 Ramon Vilanova (Universitat Autònoma de Barcelona, Spain)

A sampled-data proportional-integral-derivative (PID) control system is designed for a second-order plus dead-time system which includes an under-damping system, where the controlled plant and the controller are continuous-time and discrete-time systems, respectively. In order to guarantee the stability margin, the maximum value of the sensitivity function is used for designing the proposed control system. As a result, the control system is optimized subject to the user-specified stability margin. Because the relationship between the stability margin with the tracking performance is trade-off, the stability margin is selected based on the modeling accuracy. Hence, high tracking performance is selected when the modeling error is small. Furthermore, because the proposed PID control system is designed for a normalized system, the optimal PID parameters are calculated without solving the optimization problem.



### OS3-3 Experimental Evaluation of a Data-Driven Control System using an Electronic Thermal Regulator

Yuka Okubo, Yoichiro Ashida, Takuya Kinoshita, Toru Yamamoto  
 (Hiroshima University, Japan)

Since majority of industrial processes are of nonlinearities, a data-driven PID controller has been proposed to deal with such processes. According to that scheme, the suitable set of PID parameters are automatically computed based on a set of I/O data stored in the database. However, the data-driven technique is hardly implemented in the electronic thermal regulator due to restricted memory capacity. Therefore, the platform is required, in which the PID parameters are calculated by data-driven technique and are sent to the electronic thermal regulator shown in Fig. 1. In this study, the control results will be shown to demonstrate the effectiveness of the proposed scheme by conducting the experiment.

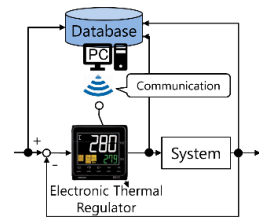
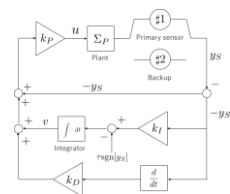


Fig. 1. Proposed platform.

### OS3-4 Self-repairing Adaptive PID Control for Plants with Sensor Failures

Masanori Takahashi (Tokai University, Japan)

In our previous works, several types of self-repairing controls have been developed for plants with unknown sensor failures. The self-repairing control system (SRCS) can automatically replace the failed sensor with the healthy backup to maintain its stability if the failure occurs. However, in most existing SRCSs, roughly estimated parameters of plants are required. This paper presents a new design method for a self-repairing adaptive PID control system. The control system has the adaptive adjusting mechanisms for the PID gains, and also can detect the sensor failure by self-test using the integrator (I-controller). Hence, for plants with unknown parameters, SRC can be successfully attained. Furthermore, in this paper, the control performances (stability, failure detection and recovery) are theoretically analyzed.





### OS3-5 Design and Development of a Constant Temperature Reservoir for a Database-Driven Smart Cultivation System

Shin Wakitani, Sharma Sneha, and Toru Yamamoto (Hiroshima University, Japan)

Decreasing the number of agricultural working population is serious problem. Production of agricultural products in plant factories is as one of the solutions to the above problems. However, it is not easy to set optimal environment conditions for many kinds of plants in food factories. This research aims for realization of a smart plant cultivation system that uses a database as a core technique. In this work, a small size constant temperature reservoir that can control several environment conditions is developed, and a simulator of the system is designed. Moreover a database-driven nonlinear temperature control is performed.



Fig. 1 Cultivation System

### OS3 New Challenges to Adaptive & Learning Control-2 (4)

#### OS3-6 Design of a Performance-Adaptive 1-Parameter Tuning PID Controller

Yoichiro Ashida\*, Shin Wakitani\*, and Toru Yamamoto (Hiroshima University, Japan)

Many self-tuning PID controllers have been proposed. In these controllers, PID gains are tuned adaptively and can maintain a good control performance to time-variant systems. However, it is difficult to employ these methods to actual systems because of low reliability of an on-line PID gain estimator. In addition, it is not preferred to tune three PID gains simultaneously in terms of the safeness of a closed loop system. In this work, a performance adaptive controller that has two stage of PID parameters tuning mechanisms is proposed. One of the tuners is a one-parameter tuner which calculates only proportional gain using the recursive least squares. The other is a PID gain tuner using ordinary least squares. When the one-parameter tuner cannot maintain a good control performance, the PID gain tuner determine new PID gains to maintain good control performance. The effectiveness of the proposed method is evaluated by a simulation example.

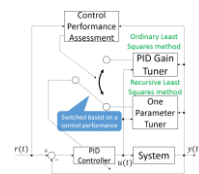
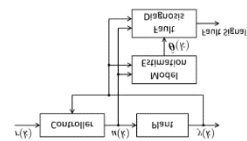


Fig. 1. Block diagram.

### OS3-7 Sticking Fault Detecting Method for CARIMA Model

Toyoaki Tanikawa, Tomohiro Henmi  
(National Institute of Technology, Kagawa College, Japan)

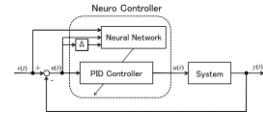
To improve the safety of control systems, it is important to detect various system faults automatically. This paper proposes a sticking fault detecting method on CARIMA model which detect the sticking fault of both the input and the feedback value. It consists of model estimation and a fault diagnosis. In the model estimation, the system parameters are estimated from the input and output data using the recursive least square method with the forgetting factor. On the other hand in the fault diagnosis, an evaluation function derived from CARIMA model is introduced. It generates a fault signal from the input and output data of the detecting period, using the estimated system parameters. Numerical simulations are performed and it is shown that this method can detect the sticking fault of the input and the feedback value.



## OS3-8 Design of a Neural Network based on E-FRIT and Its Application

Kento Kinoshita, Shin Wakitani, Shuichi Ohno (Hiroshima University, Japan)

PID controllers have been widely used for process systems. However, a good control result is not always obtained with fixed PID gains when a controlled object has nonlinearity. This paper proposes a design method for a nonlinear PID controller that utilizes a neural network to overcome the problem. In the proposed controller, PID gains are tuned online by a neural network and a controlled object is manipulated by the PID controller with the tuned PID gains. The neural network is learned by an offline learning algorithm based on the extended fictitious reference iterative tuning (E-FRIT) and the backpropagation. E-FRIT is a method that tunes control parameters directly by using operating data. Simulation examples are provided to show the effectiveness of the proposed method. Moreover, the experimental result of a level control of a tank system is also given to demonstrate the performance of the proposed method.

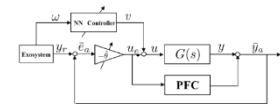


## OS3-9 Parameter Optimization with Input/Output data via DE for Adaptive Control System with Neural Network

Taro Takagi (National Institute of Technology, Maizuru College, Japan)

Ikuro Mizumoto (Kumamoto University, Japan)

During the last decades, several almost strictly positive real (ASPR) based adaptive control systems have been proposed. ASPR based adaptive control systems have a robustness with respect to uncertainty and disturbance. However, ASPR conditions are severe conditions for actual systems. Therefore, the introduction of parallel feedforward compensator (PFC), which made it possible to construct ASPR based adaptive control system, has been proposed. Also, feedforward input generated by neural network (NN), which can eliminate the tracking error caused by PFC, has been recently proposed and ASPR based adaptive control system became more practical method. Although the method became practical, it is still difficult to adopt because the parameters of adjust law for NN have to be decided by the designer and it will be decided by trial and error. In this paper, the parameter optimization of PFC and NN will be done by using one-shot experimental data via differential evolution.

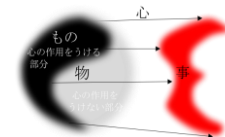


## OS4 Aspects of Natural Computing (3)

### OS4-1 Mathematical Expression of *Minakata Kumagusu's* Philosophy of Natural Science

Yasuhiro Suzuki (Nagoya University, Japan)

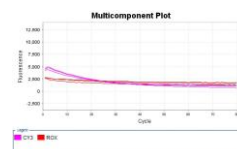
A mission of Natural Computing is understanding nature by algorithms; since an algorithm is just a sequence of computing steps, we have to extract an “algorithm” from nature which requires “viewpoints” that indicate “how to observe and consider”. Minakata Kumagusu [1867-1941], a Japanese naturalist, proposed a novel philosophy of science based on Buddhism and it affords the viewpoint. However, his philosophy of science has almost been ignored, hence we extract the principle of his philosophy from the viewpoint of Natural Computing and transform it into a mathematical form by using Category Theory.



## OS4-2 Toward Artificial Intelligence by Using DNA Molecules

Yasuhiro Suzuki, Rie Taniguchi (Nagoya University, Japan)

Molecular Robotics have been realized by using bio molecules such as DNA or proteins, for example in the Molecular Robotics Research Project [2012-17, JSPS]. Such bio molecules, like DNA or proteins, are highly structured. They already have a kind of “intelligence” and adapt to environmental change. Hence, we have tried to extract their “ability” in order to induce intelligence artificially. We have used well-known DNA reactions, *Seesaw gate reaction*, and we found that DNA molecules can sense the concentration of a single strand input sequence or quasi-input (mismatch, point mutation, including sequence) and choose the one with higher concentration. This result shows that DNA molecules (short DNA sequences) can adapt to their environment.



## OS4-3 Differentiation and Integration of Sensation and its Application

Yasuhiro Suzuki (Nagoya University, Japan)

Our senses can be seen as a dynamical system in a multi-dimensional sensory space, where each dimension corresponds to a type of sense such as vision, hearing, touch, and so on. Our sensory systems are composed of differentiators and we perceive sensory stimulations through differentiating sensory stimulations. In order to calculate the differentiation of sense, we have to set a measurable quantity of the sense. We can not only use quantity measures such as brightness of picture or loudness of sound, but also quality measures like the value of Semantic Differential (SD) method for measuring impressions or emotions, such as beauty, fear, happiness. We propose a method of Differentiation and Integration of sensation and we show the application of this method by transforming a painting of *Piet Mondrian's "1921"* into a music piece.

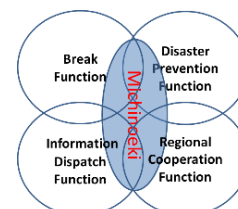


## OS5 Advanced Regional Engineering (4)

### OS5-1 Discovering Successful Determinants of Efficiency of MICHINOEKI in Chugoku Area

Minoru Kumano(University of Miyazaki, Japan),Takao Ito(University of Hiroshima, Japan),  
Toru Hiraoka(University of Nagasaki, Japan), Hirofumi Nonaka(Nagaoka University of  
Technology, Japan), Masaharu HirotaOkayama University of Science, Japan)

Many theories and analyses of Michinoeki from the viewpoints of break function, information dispatch function, and regional cooperation function have been published in the past decades. Based on our investigation, additional dimensions called disaster prevention function need to be added because a variety of activities have been developed recently. Specific to the context of Michinoeki systems, this paper develops and empirically tests a mathematical model of Michinoeki from the standpoint of how those four basic functions significantly influence its performance, thus uniquely contributing to extant knowledge. Using data drawn from Michinoeki in Chugoku area, this research attempts to shed light on the relationship between four basic functions and its performance including sales revenue and number of customers who passed through the shop cashier, to confirm the validity of the new four function model. Based on the findings, the managerial implications are discussed, the study limitations are identified and directions for further research are suggested.



## OS5-2 Relationship Analysis on the Number of Customers of Michinoeki in Kyushu Region

Toru Hiraoka, Shiori Nishimura (University of Nagasaki, Japan), Hirofumi Nonaka (Nagaoka University of Technology, Japan), Minoru Kumano (University of Miyazaki, Japan)

We extract relevant factors or existence of facility / service to the number of customers of Michinoeki in Kyushu region, and estimate the number of customers from each factor or existence of facility / service. We pick up facility area (whole), facility area (sales office), number of parking units, traffic volume, number of items (sales office), overall project cost, and municipal population. By correlating these factors and the number of customers, we find factors that are related to the number of customers. And we pick up the 44 facilities / services, and analyze the correlation between the 44 facilities / services and the number of customers. In addition, we perform multiple regression analysis to estimate the number of customers from these factors or existence of facilities / services, and verify the performance of multiple regression equations for each factor or existence of facility / service.

Table Correlation analysis of the number of customers and factors

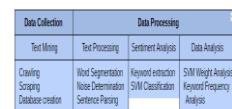
Data name	Correlation coefficient
Number of parking units	0.525
Facility area (sales office)	0.460
Traffic volume	0.428
overall project cost	0.204
number of items (sales office)	0.156
facility area (whole)	-0.122
municipal population	-0.111

## OS5-3 Emotional Contribution Analysis of Online Reviews

Elisa Claire Alemán Carreón, Hirofumi Nonaka (Nagaoka University of Technology, Japan), Toru Hiraoka (University of Nagasaki, Japan), Minoru Kumano (University of Miyazaki, Japan), Takao Ito (Hiroshima University, Japan), Masaharu Hirota (Okayama University of Science, Japan)

In response to the constant increase in population and tourism worldwide, there is a need for the development of cross-language market research tools that are more cost and time effective than surveys or interviews. In order to address the issue, we extracted the most influential keywords in emotional judgement from Chinese online reviews. Using an entropy based mathematical model and SVM, we determined the words that most closely represent the demands and emotions of this customer base. Classifying these words further as grammatical or subject words, we analyzed both the tendencies in writing online reviews for this customer base and their specific topics of interest.

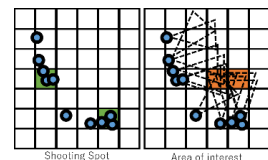
Overview of Our method



## OS5-4 An Approach to Visualize Place of Interest and Shooting Spot Using Geo-Tagged Photographs

Masaharu Hirota (Okayama University of Science, Japan), Masaki Endo (Polytechnic University, Japan), Hiroshi Ishikawa (Tokyo Metropolitan University, Japan)

In this paper, we extract shooting spots and area of interests using geo-tagged photographs from social media sites. Shooting spot is one of a type of hotspot in an area where many photographs have been taken. Also, area of interest is usually attractive as a tourist spot for many people (e.g., Colosseum, Statue of Liberty). These area is useful to analyze tourism industry. We demonstrate our approach by extracting areas of interest and shooting spot using photographs annotated with metadata from Flickr.

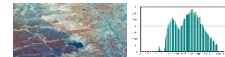


## OS6 Kansei Engineering and Applications (4)

### OS6-1 Histogram Analysis Method Based on Gaussian Distribution and Curvature Computation (I) ---- Peaks and Valleys Detection ----

Yusuke Kawakami\*, Tetsuo Hattori\*\*, Yoshiro Imai\*\*, Kazuaki Ando\*\*,  
Yo Horikawa\*\*, R. P. C. Janaka Rajapakse\*\*\*  
(\*DynaxT Co., Ltd., Japan), (\*\*Kagawa University, Japan)  
(\*\*\*Tainan National University of the Arts, Taiwan)

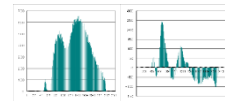
This paper presents an analysis method of image histogram using curvature computation based on Gaussian distribution. By the image histogram and curvature computing over the cumulative histogram, we can not only detect the peaks and valleys in the image histogram, but also obtain the accompanying information on the peaks and valleys such as those shapes and sizes. In this paper, we propose the information extraction method from image histogram using the curvature computation, based on the assumption that the peaks and valleys are approximated by the same number of Gauss density functions.



### OS6-2 Histogram Analysis Method Based on Gaussian Distribution and Curvature Computation (II) ---- Experimentation ----

Yusuke Kawakami\*, Tetsuo Hattori\*\*, Yoshiro Imai\*\*, Kazuaki Ando\*\*,  
Yo Horikawa\*\*, R. P. C. Janaka Rajapakse\*\*\*  
(\*DynaxT Co., Ltd., Japan), (\*\*Kagawa University, Japan)  
(\*\*\*Tainan National University of the Arts, Taiwan)

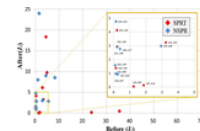
This paper presents an analysis method of image histogram using curvature computation based on Gaussian distribution. By the image histogram and curvature computing over the cumulative histogram, we can not only detect the peaks and valleys in the image histogram, but also obtain the accompanying information on the peaks and valleys such as those shapes and sizes. In this paper, we expose the experimental results and show the effectiveness of the proposed method.



### OS6-3 Experimental Evaluation of Change Detection Ability in New Sequential Probability Ratio

Yoshihide Koyama<sup>\*1</sup>, Tetsuo Hattori<sup>\*1</sup>, Yoshiro Imai<sup>\*1</sup>, Yo Horikawa<sup>\*1</sup>, Yusuke Kawakami<sup>\*2</sup>,  
Hiromichi Kawano<sup>\*3</sup>, Takeshi Tanaka<sup>\*4</sup> (<sup>\*1</sup>Kagawa University, <sup>\*2</sup>DynaxT Co., Ltd.,  
<sup>\*3</sup>NTT advanced technology Co., Ltd, <sup>\*4</sup>Hiroshima Institute of Technology, Japan)

Previously, we have already proposed a novel method using New Sequential Probability Ratio (NSPR) for the structural change detection problem of ongoing time series data instead of using SPRT (Sequential Probability Ratio Test). And in the previous paper, we have revealed the experimental results by applying the both methods, i.e., NSPR and SPRT, to time series data that are generated by a multiple regression model. In this paper, we present the evaluation results of NSPR more concretely in two cases.

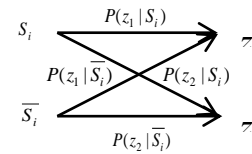


## OS6-4 Application Proposal of Sequential Probability Ratio to Dynamic System

### State Estimation

Tetsuo Hattori<sup>\*1</sup>, Yusuke Kawakami<sup>\*2</sup>, Yoshihide Koyama<sup>\*1</sup>, Yoshiro Imai<sup>\*1</sup>, Yo Horikawa<sup>\*1</sup>, Hiromichi Kawano<sup>\*3</sup>, Takeshi Tanaka<sup>\*4</sup> (<sup>\*1</sup>Kagawa University, <sup>\*2</sup>DynaxT Co., Ltd., <sup>\*3</sup>NTT advanced technology Co., Ltd, <sup>\*4</sup>Hiroshima Institute of Technology, Japan)

Previously, we have already presented a relation between the SPRT (Sequential Probability Ratio Test) based on two hypotheses (i.e. Null hypothesis and Alternative hypothesis) and a binary channel in information theory. And we have shown that the Bayes' updating process for obtaining a posteriori probability by the received signal through binary channel is very similar to the SPRT computing. In this paper, extending the definition of SPRT to the multi hypotheses condition, we propose to apply the extended SPRT to the internal state estimation of dynamic system.

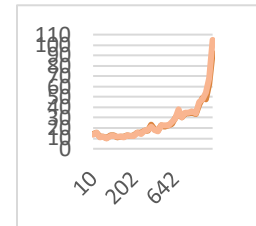


## OS7 Mobile Robotics (8)

### OS7-1 An Empirical Evaluation of Grid-based Path Planning Algorithms on Widely Used in Robotics Raspberry Pi Platform

Anton Andreychuk, Andrey Bokovoy (RUDN University, Russian Academy of Sciences, Russia) Konstantin Yakovlev (Russian Academy of Sciences, Higher School of Economics, Russia)

We compare three widely used grid-based path planning algorithms, A\*, Jump Point Search, Theta\*, in terms of runtime performance on a desktop personal computer and on the Raspberry Pi 2 embedded computer widely used in modern robotics. We also evaluate the performance of recently introduced angle-constrained path planning algorithm, LIAN, on both computers. Two principal questions are targeted. First: to what extent modern embedded computers are slower than conventional desktops when solving path finding problems on grids. The answer is – one order of magnitude. Second: how well the former scale up to larger problems. The answer is – in the same way as desktop PCs. To provide a fair comparison all the algorithms are coded from scratch using the same data structures and programming techniques.



### OS7-2 Development of the insectoid walking robot with inertial navigation system

Vitaly Egunov, Andrey Kachalov, Michail Petrosyan, Pavel Tarasov, Elena Yankina (Volgograd State Technical University, Russia)

The article is devoted to the problem of managing the walking insectoid robot - hexapod. The developed robot uses an inertial navigation system based on accelerometer ADXL345 and gyroscope ITG-3200. Options for filtering data received from the inertial sensors, the methods of combining accelerometer and gyroscope data for determining the roll and pitch are considered. To visualize the position of the mobile robot the original software was designed. The program was developed for a microcomputer that transmits the calculated total variance (roll and pitch) over a wireless Wi-Fi network to the personal computer running program that processes data values. The obtained data is processed and used to display the object with the help of the OpenGL library.

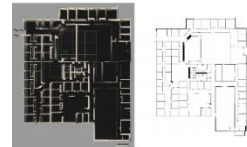


### **OS7-3 Enhancing semi-dense monocular vSLAM used for multi-rotor UAV navigation in indoor environment by fusing IMU data**

Andrey Bokovoy (Russian Academy of Sciences, RUDN University, Russia)

Konstantin Yakovlev (Russian Academy of Sciences, Higher School of Economics, Russia)

We propose the enhancement of the modern vision-based monocular simultaneous localization and mapping (vSLAM) method, e.g. LSD-SLAM, used for compact multi-rotor UAV indoor navigation, by fusing inertial measurement unit (IMU) data with camera images. We suggest removing the cost-expensive loop-closure optimization algorithm from the vSLAM pipeline and replacing it with the computationally efficient flow estimation procedure based purely on IMU data. The input IMU flow is being processed by the Extended Kalman Filter based techniques for localization purposes and used further in LSD-SLAM algorithm for UAV pose estimation. We evaluate the proposed algorithm using the modeled indoor environment originally used for RoboCup Rescue Simulation League 2013 competition and “hector\_quadrotor” – commonly used in modelling simulated UAV model. Evidently, implementation of the suggested enhancement procedure results in significant drop-down of the runtime and leads to obtaining maps and trajectories of higher accuracy.



### **OS7-4 Method of finding the android program motion for the ZMP trajectory of a certain type**

Alexander Gorobtsov, Pavel Tarasov, Andrey Skorikov, Alexey Markov, Andrey Andreev  
(Volgograd State Technical University, Russia)

The problem of finding the program motion of biped robot with a given ZMP trajectory is considered. It is assumed that this provides a stable ZMP trajectory of the robot motion. The equations of the robot motion consist of the equations of the robot dynamic itself and the stability conditions equations, which include the coordinates of the ZMP trajectory. It is proposed to seek the solution of stability equations on a limited set of some concerted movements of the robot. Several types of such concerted movements are considered. The application of this method for the android with a mass of 60 kg and height of 160 cm is described. To implement the method the original multibody system dynamics modeling software (MBS software) is used. The computational aspects of the method and approaches to speed-up computations are considered.



## OS7-5 Path Planning for Indoor Partially Unknown Environment Exploration and Mapping

Aufar Zakiev<sup>1</sup>, Roman Lavrenov<sup>1</sup>, Vadim Indelman<sup>2</sup>, Evgeni Magid<sup>1</sup>  
(<sup>1</sup>Kazan Federal University, Russia)  
(<sup>2</sup>Technion-Israel Institute of Technology, Israel)

This paper addresses a problem of partially unknown environment exploration and mapping. The proposed path planning algorithm provides global and local goals search taking into account limited sensing range and visibility constraints that arise from obstacles. Looking for local goals near a global path maximizes robot utility and helps avoiding returns to regions with low potential gain. All stages were tested in ROS/Gazebo simulations and results were compared with a naive algorithm that was proposed earlier.



## OS7-6 Simulation of service robot swarm behavior

Alexei Lushnikov<sup>1</sup>, Vlada Kugurakova<sup>1</sup>, Timur Satdarov<sup>2</sup>, Artur Nizamutdinov<sup>1</sup>  
(<sup>1</sup>Higher School of ITIS, Kazan Federal University, Russia, <sup>2</sup>KUKA Robotics, Russia)

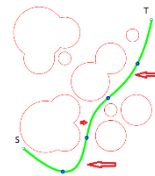
In this paper, we present an implementation 3D simulation of a swarm of intelligent service robots in Unity3D. Swarm's task and purpose is clean-up of an assigned area. We compared and analyzed different possible algorithms of such swarm's behavior. Implementation includes prevention of collision between robots themselves and humans that walk through their area of effect and can be expanded to any other obstacle, moving or stationary. The implementation is suitable for serving as a basis for future real-life construction of a service robot swarm.



## OS7-7 Smart Spline-Based Robot Navigation on Several Homotopies: Guaranteed Avoidance of Potential Function Local Minima

Roman Lavrenov (Kazan Federal University, Russia)

Potential function based methods provide powerful solutions in tasks of local and global path planning. They are characterized implementation simplicity, but suffer from navigation function local minima. In this paper we propose a modification of our original spline-based planning algorithm. Voronoi-based approach provides a good initial path as first iteration. A new safety criterion is integrated into path planning to guarantee path safety. The modified algorithm was implemented in Matlab environment and demonstrated significant advantages over the original algorithm.





## OS7-8 Virtual Experimental Stand for Automated Fiducial Marker Comparison in Gazebo Environment

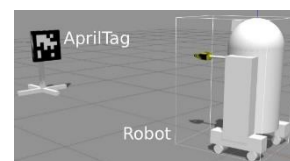
Ksenia Shabalina<sup>1</sup>, Artur Sagitov<sup>1</sup>, Hongbing Li<sup>2</sup>, Edgar A. Martinez-Garcia<sup>3</sup>, Evgeni Magid<sup>1</sup>

(<sup>1</sup>Kazan Federal University, Russia)

(<sup>2</sup>Shanghai Jiao Tong University, China)

(<sup>3</sup>Universidad Autónoma de Ciudad Juárez, Mexico)

Fiducial marker systems are used by multiple visual applications, including robotics, augmented reality, industrial production, good packaging and dispensing, and all these applications require certain quality assurance for markers. In this paper, we present an experimental automated approach for fiducial marker systems comparison in virtual environment. Previously, in a set of pilot experiments, we had compared ARTag, AprilTag, CALTag marker systems under three types of conditions: systematic occlusion, arbitrary overlap with an object and marker rotation. In effort to statistically improve our previous work, we faced a necessity to conduct over a thousand of additional experiments and, as such amount of experiments is impossible to perform manually, we constructed a virtual robot in Gazebo environment that performs all necessary manipulations. This paper overviews our environment and automated comparison algorithm. Further, we will introduce Gaussian noise in order to bring our virtual experiments closer to real world conditions.



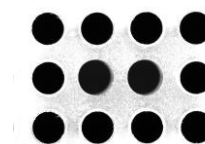
## OS8 Intelligence Control Systems and Applications (11)

### OS8-1 An Automated Optical Inspection system for a tube inner circumference state identification

Chung-Wen Hung, Jhen-Gu Jiang, Hsien-Huang P. Wu, Wei-Lung Mao

(National Yunlin University of Science & Technology, Taiwan)

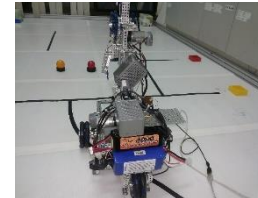
An Automated Optical Inspection, AOI, system for a tube inner circumference state identification is proposed. In order to improve the efficiency of the traditional chopsticks industry in the process, the AOI system is developed. In the chopsticks production line, this AOI system is installed after the material feed equipment to complete the screening to reduce the unnecessary cost of expenditure. Chopsticks tube states identification base on the machine vision software –MVTec HALCON, and it will be implemented with EmguCV library. The different algorithms of image processing are used to sort the material into five groups: “Normal”, “Large”, “Small”, “deformation” and “empty”. The algorithm will be detailed in this paper, and the experimental results will also be shown in this paper to present the proposed AOI system is workable.



## OS8-2 Implementation of the Mobile Based Robot Arm for Image Recognition

Ji-Hua Li, Jr-Hung Guo, Kuo-Lan Su  
(National Yunlin University of Science & Technology, Taiwan)

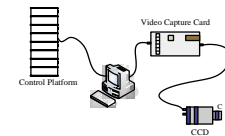
The paper develops a mobile based robot arm using KNRm system. The mobile based robot arm contains two parts : One is mobile platform: The other is a four-joint robot arm. The core of the KNRm system uses the NI Single-Board RIO 9606 module that is manufactured by National Instruments (NI) Company. The structure of the mobile based robot arm is built by Matrix element. The mobile based robot arm integrates some sensors, three DC servomotor motors, four RC servomotors, a controller, and an image processing module. Trapezoidal acceleration and deceleration algorithm and Proportional-Integral-Derivative (PID) algorithm are used to control each DC servomotor. The mobile platform embeds a robot arm with four degrees of freedom on the front side. The driver device of the robot arm is RC servomotor. In the experimental results, the mobile based robot arm can search and recognize the assigned billiard ball using image binarization method and Otsu algorithm by the image system. Finally, the robot arm moves approach to the assigned color ball, and catches the ball moving to the assigned position, and puts down the ball.



## OS8-3 Reinforced Quantum-behaved Particle Swarm Optimization Based Neural Networks for Image Inspection

Li-Chun Lai, Chia-Nan Ko (Nan Kai University of Technology, Taiwan)

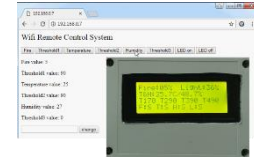
The paper combines the niche particle concept, quantum-behaved particle swarm optimization (QPSO) method with chaotic mutation to train neural networks for image inspection. When constructing the reinforced quantum-behaved particle swarm (RQPSO) to train neural networks (RQPSONNs) for image inspection, first, image clustering is adopted to capture feasible information. Then the database of image can be built. In this research, the use of support vector regression (SVR) method determines the initial architecture of the neural networks. After initialization, the neural network architecture can be optimized by RQPSO. Then the optimal neural networks can perform image inspection. In this paper, the program of RQPSONNs for image inspection will be built. The values of root mean square error (RMSE) and peak signal to noise ratio (PSNR) are calculated to evaluate the efficiency of the RQPSONNs. Moreover, the experiment results will verify the usability of the proposed RQPSONNs for inspecting image. This research can be used in industrial automation to improve product quality and production efficiency.



## OS8-4 Development of IoT Module with Backup and Data-security Functions

Jr-Hung Guo, Kuo-Hsien Hsia, Kuo-Lan Su  
(National Yunlin University of Science & Technology, Taiwan)

Internet of Things (IoT) is one of the most popular research topics. There have been many studies and products about this topic. However, there is few researches about the correctness of data and the mutual support of modules. In this paper, we developed an IoT module with multi-sensor and communication interface. It debugs and confirms the data from multiple modules and sensors using the fusion and the redundant algorithms. It can also sustain or replace a possibly fail IoT module via multiple communication interface. The dynamic identification technology is used to ensure the security of data transmission. Hence the IoT system can be more stable and more secure. In this paper, the program of RQPSONNs for image inspection will be built. The values of root mean square error (RMSE) and peak signal to noise ratio (PSNR) are calculated to evaluate the efficiency of the RQPSONNs. Moreover, the experiment results will verify the usability of the proposed RQPSONNs for inspecting image. This research can be used in industrial automation to improve product quality and production efficiency.



## OS8-5 Development of Auto-Stacking Warehouse Truck

Kuo-Hsien Hsia, Ming-Guang Wu, Jun-Nong Lin, Hong-Jie Zhong, and Zh-Yao Zhuang  
(Far East University, Taiwan)

Warehouse automation is a very important issue for the promotion of traditional industries. For the production of larger and stackable products, it is usually necessary to operate the stacker for the stacking and storage of the products. The general autonomous warehouse-truck does not have the ability of stacking objects. In this paper, we develop a prototype of auto-stacking warehouse-truck that can work without direct operation by a skill person. Just commanded with an RFID card, the stacker truck can move under the prior-planned route, and pick and deliver the product from the designated storage area or deliver and put the product to the designated storage area in the warehouse. It can significantly reduce the manpower requirements of the skilled-person of fork lift technician and improve the safety of the warehousing area.



## OS8-6 Development of Four-axis SCARA Robotic Arm Built on Automation Control System

Jr-Hung Guo, Kuang-Wei Chuang, Kuo-Lan Su  
(National Yunlin University of Science & Technology, Taiwan)

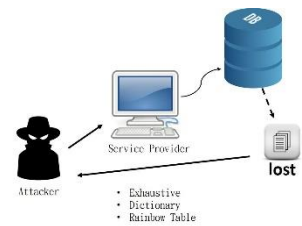
The paper presents a integral design method to integrate “DFM” (Design for Manufacturing) and “DFV” (Design for Verification), and completes the production system from simulation to actual verification using the SCARA robot arm. In the aspect of kinematics of horizontal joint, the 2D model is established by mathematical derivation and the analysis of the robot arm characteristics using “Jacobian” kinematic, and integrates into the verification design. The electromechanical integration of the proposed system is combined SCARA’s characteristics, automatic control components, sensors; electrical, pneumatic circuit design and software programming for implement. Then user can lead the robotic arm to run the coordinates and movement path with proper accuracy, efficiency and reliability. The program language of the SCARA uses “DRL” (DELTA Robot Language) that is developed by DELTA Company. This research also proposes a design method using automatic palletizing simulate layout for the SCARA robot arm, and uses the framework of “IoT” (Internet of Things) to build the near-end and remove applications via LAN and WLAN (WiFi).



## OS8-7 Novel Detection Scheme for Stolen Password File

I-Hsien Liu, Chia-Hsiu Chen, Jung-Shian Li (National Cheng Kung University, Taiwan)

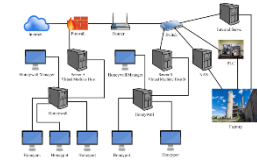
Over the past decades, with the popularity of personal computers and mobile devices, the convenience of the Internet, and the development of social networks, more and more people rely on the Internet to deal with or share things on life, such as online payment, online shopping, etc. All of the above are need to use the user authentication to achieve identity confirmation in order to use the appropriate application. The evolution of the password so far has developed a variety of forms to achieve certification. For example, fingerprints, sound waves, retina and so on. However, the traditional digital password authentication credential is still widely accepted by the public, but in the past few decades, the content of this certification mechanism hasn’t been much change. The use of traditional password is the most common and important authentication credential for today’s online society. However, with the fast development of network technology and easily memorized and guessed password with low strength, password cracking events frequently occur. Consequently, the password files are leaked. The events are not easily to be detected and it results in great business losses. How to avoid password cracking and detect the event of stolen password file has become an important information security issues. Recently, Juels and Rivest published a paper about Honeyword system using one account with multiple passwords for detection of illegal intrusions. Our research explores the relevant password cracking technology and password-related policy. Accordingly, our research improves the Honeyword system proposing a new password storage mapping method. If the password file is stolen, an attacker could not know any user’s correct password. This method can reduce additional space of storing passwords with ability to detect security event for stolen password files. We apply our method to the latest version of OpenLDAP Server to prove its feasibility.



## OS8-8 Honeypot System of SCADA Security Survey

Kuan-Chu Lu, I-Hsien Liu, Jung-Shian Li (National Cheng Kung University, Taiwan)

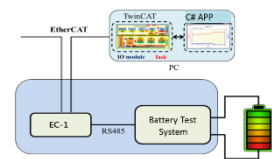
Now the essential infrastructure is used SCADA system monitoring, like nuclear plants, Water Conservancy Bureau, manufacturing, and logistics industry. With the rapid development of the internet, now the IOT (internet of things) turn every massive infrastructure from the closed network into the open way made the whole system became more convenient. by contrast, the system will face the threat never before, that is why the whole system needs to build a safe and protected mechanism through remote control for prevented the external attack, to avoid SCADA system crashed lead to international security and economy issue. For protecting the important assets, we need to understand the tools can preserve system safety to prevent the attackers invade the SCADA system. This study investigating the defense mechanism of the SCADA system and proposed an effective defensive structure to protected the safety of SCADA system.



## OS8-9 An EtherCAT Battery Test System

Chung-Wen Hung , Bo-Min Wang, Wen-Ting Hsu, Jhen-Gu Jiang  
(National Yunlin University of Science & Technology, Taiwan)

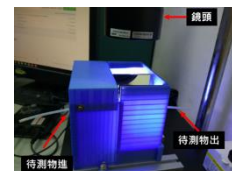
A battery test system is a key equipment to ensure lifetime of batteries and portable device performance. On the other hand, because of the real time requirement in industry 4.0, EtherCAT communication is considered a standard interface of industry 4.0. It is based on the Ethernet hardware, and its advantages are larger transmission bandwidth, shorter update time, and on minimum synchronization time jitter. In order to support EtherCAT communication function for battery test systems, this paper purposed an EtherCAT interface for an original battery test system. The TwinCAT environment developed by Beckhoff is adopted to be the EtherCAT interface Master, and Renesas's EC-1 evaluation board is used as the EtherCAT interface slave controller. The commands are sent to the battery test system through the RS485 interface and Modbus protocol from the EC-1 board. Finally, a C# software is proposed to provide friendly GUI interface for user.



## OS8-10 Surface Defect Detection for Tube Object Based on Single Camera

Hsien-Huang Wu, Chang-Jhu He (National Yunlin University of Science & Technology, Taiwan)

Extrusion tube is a very popular product in the plastic industry produced by a extruder machine, for example, tubes used in washer machine or in reverse osmosis (RO) water purification system. To guarantee the quality of the tube produced for medical use, a surface defect detection system is needed. In this paper, we use a single camera combined with a telecentric lens and properly designed mirror set to achieve the complete coverage of the object surface for full defect detection. Based on the properly designed image acquisition equipment and image analysis techniques, the final system for extrusion tube defect detection can successfully detect defects of black spots, bumps, injury, etc., with a defect detection rate of about 95%, and the detection speed is up to 1578 mm/s, which can be deployed for the online usage.



## OS8-11 Client Searching Privacy Protection in Encrypted Database

Hsien Liu, Chuan-Gang Liu, Cheng-Jui Chang, Jung-Shian Li

(National Cheng Kung University, Taiwan)

In recent years, Cloud Storage Providers (CSP) works hard to successfully achieve cheap cloud storage. To prevent losing important data in their own device, some of the people backup their data to the cloud. It becomes much more important for securing the data stored in the cloud. Although CSP claims that storage service is much more secure than before, malicious attackers invade the servers continuously. To prevent data in cloud stolen by the hackers, searchable encryption can be an useful tool. The key point of searchable encryption can relax the assumption that CSP is always truthful. Data owner can authorize users how to search and extract his files accordingly. Our proposed scheme, called SESD (Searchable Encryption Support Dynamic), provides multi-keyword based searchable encryption method for the semi-trusted cloud simulations, we observed the behaviors of the user searching in the encrypted cloud server. Secondly, the scheme employs a more dynamic way on cloud storage. By verification in the cloud data service, we found the proposed scheme effective in searchable encryption.



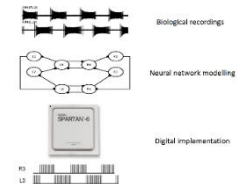
## OS9 Theory and Implementation of Neuromimetic Systems

### OS9-1 Study of real-time biomimetic CPG on FPGA: behavior and evolution

Timothée Levi<sup>1,2</sup>, Kazuyuki Aihara<sup>1</sup>, Takashi Kohno<sup>1</sup>

(<sup>1</sup>The University of Tokyo, Japan, <sup>2</sup>University of Bordeaux, France)

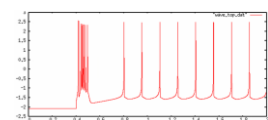
Locomotion is one of the most basic abilities in animals. Neurobiologists have established that locomotion results from the activity of half-center oscillators that provides alternation of bursts. Central Pattern Generators (CPGs) are neural networks capable of producing rhythmic patterned outputs without rhythmic sensory or central input. We propose a network of several biomimetic CPGs using biomimetic neuron model and synaptic plasticity. This network is implemented on a FPGA (Field Programmable Gate Array). The network implementation architecture operates on a single computation core and in real-time. The implementation of this CPGs network is validated by comparing it with biological data of leech heartbeat neural network. From these CPGs, we study the evolution and the behavior of chains of CPGs to understand how CPG evolves over time and how single broken CPG can be fixed.



### OS9-2 A Metaheuristic Approach for Parameter Fitting in Digital Spiking Sillion Neuron Model

Takuya Nanami, Takashi Kohno (The University of Tokyo, Japan)

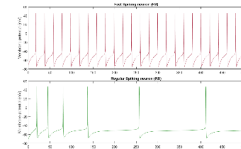
DSSN model is a qualitative neuronal model designed for efficient implementation in digital arithmetic circuit. In our previous studies, we developed automatic parameter fitting method using the differential evolution algorithm for regular and fast spiking neuron classes. In this work, we extended the method to cover low-threshold spiking and intrinsically bursting. Firstly, we optimized parameters of the fast subsystem of the DSSN model in order to reproduce that of the ionic-conductance model. Secondly, we optimized remaining slow parameters of the DSSN model that control bursting dynamics in order to reproduce that of the ionic-conductance model.



### OS9-3 Real-time Digital Implementation of HH neural network on FPGA: cortical neuron simulation

Farad Khoyratee<sup>1</sup>, Sylvain Saïghi<sup>1</sup>, Timothée Levi<sup>1,2</sup>  
(<sup>1</sup>University of Bordeaux, France, <sup>2</sup>The University of Tokyo, Japan)

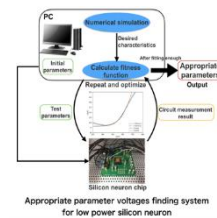
Millions of people worldwide are affected by neurological disorders. The long-term goal of replacing damaged brain areas with artificial devices also requires the development of neuronal network models. The hardware set-up that will be used to interface the biological component is a Spiking Neural Network (SNN) system. This SNN implements biologically realistic neural network models, spanning from the electrophysiological properties of one single neuron up to network plasticity rules. The most biologically relevant mathematical neuron model was proposed in 1952 by Hodgkin and Huxley (HH). Here, we propose a real-time digital implementation of hundreds biomimetic HH neurons designed by FPGA as a central processing unit and DAC (Digital to Analog Converter) as the spike generator. To validate our HH neuron, we simulate different neuron family of cortical neurons. This research will be used for neurological disease modeling and bio-hybrid experiments.



### OS9-4 Finding appropriate parameter voltages for driving a low-power analog silicon neuron circuit

Atsuya Tange, Takashi Kohno (The University of Tokyo, Japan)

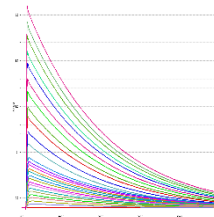
Silicon neurons are VLSI circuits that which mimic the dynamical behaviors of real neurons with electronic circuits. They are expected to be used as elements in large-scale networks of artificial biomimetic neuron circuits or bio-silico hybrid systems. We focused on a silicon neuron circuit designed by with a qualitative neuronal modeling approach for low power consumption. But this circuit can mimic a variety of neuronal cell classes by selecting appropriate values for its bias voltages. Its characteristics are influenced by some factors like temperature or mismatch and secondary effects of transistors. These factors cause error between numerical simulation results in the designing stage and the characteristics of implemented circuits. Therefore we have to tune parameter the bias voltages of individual neuron circuits to get desired dynamical behaviors after circuit implementation. We constructed the algorithm to automatically find appropriate values of the parameter bias voltages.



### OS9-5 A low-power silicon synapse circuit with tunable reversal potential

Ashish Gautam, Takashi Kohno (The University of Tokyo, Japan)

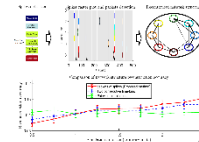
Synapses are the basic building blocks of signal processing and computation in both real and artificial simulated neuronal networks. We present the concept and simulation results of a pseudo five bit, low power silicon synapse circuit that emulates realistic postsynaptic current profiles by fitting them using the exponential current-voltage relationship of MOSFET in the sub-threshold regime of operation. Adjusting the parameters, our circuit is capable of generating both excitatory (AMPA/NMDA type) and inhibitory (GABA type) postsynaptic currents covering a wide range of time constants. Also emulating the real synapse, the post-synaptic current is proportional to the difference between the postsynaptic membrane potential and a tunable synaptic reversal potential.



## OS9-6 New methodology of neural network reconstruction for "in vitro" culture on Multi Electrode Array (MEA)

Timothée Leleu<sup>1</sup>, Timothée Levi<sup>1,2</sup>, Takashi Kohno<sup>1</sup>, Kazuyuki Aihara<sup>1</sup>  
(<sup>1</sup>The University of Tokyo, Japan, <sup>2</sup>University of Bordeaux, France)

The realization of neural prostheses, that could improve the quality of life for millions of people around the world affected by cognitive and/or motor disorders, requires understanding the details of the micro-connectivity between neurons in the biological tissue. Techniques for inferring the network structure are generally based on cross-correlations and result in ambiguous reconstruction. Recently, we have proposed a method for which there is one-to-one correspondence between statistical properties of packets of spikes (or avalanches) and the network structure. This method utilizes the higher order statistics of spike trains in order to reconstruct the network structure unambiguously. We show using numerical simulations of various biological neuron models that the proposed method is general, and is particularly well-fitted for the analysis of neural activity recorded from cultured neuronal networks coupled to microelectrode arrays.

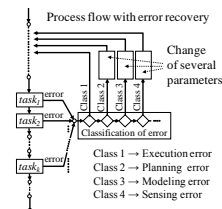


## OS10 Intelligent Robotic Manufacturing (2)

### OS10-1 Technique of Recovery Process and Application of AI in Error Recovery Using Task Stratification and Error Classification

Akira Nakamura<sup>\*1</sup>, Kazuyuki Nagata<sup>\*1</sup>, Kensuke Harada<sup>\*2</sup> and Natsuki Yamanobe<sup>\*1</sup>  
(\*<sup>1</sup> National Institute of Advanced Industrial Science and Technology (AIST), Japan  
\*<sup>2</sup> Osaka University, Japan)

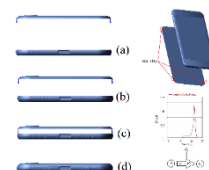
In manipulation tasks of industrial production, plant maintenance, and housework, error recovery is an important research theme for robots. However, systematical methods of error recovery have not been appeared yet. We have proposed error recovery using the concepts of both task stratification and error classification. In the error recovery, the judgment of the error is performed in processes of the practice of the system. In this paper, the recovery process after the judgment of error is described in detail. In particular, we will explain how to change the parameters of planning, modeling and sensing when error recovery is performed. This contributes to deal with error recovery systematically. On the other hand, to experience a lot of error recoveries can accumulate the data about the recovery method. Furthermore, in this paper, we also refer to apply technique of artificial intelligence such as Deep Learning to error recovery.



### OS10-2 Motion selection for 3D robotic snap assembly

Peihao Shi, Kensuke Harada, Weiwei Wan, Ixchel G. Ramirez (Osaka University, Japan)  
Juan Rojas (Guangdong University of Technology, China), Hiromu Onda (AIST, Japan)

In this paper, we aim to provide an assembly method for a snap joints assembly task. We create a 3D cellphone model and use ADAMS simulation environment to analyze the relative motion between screen and backer part. We focus on two points in this research. 1) Two kinds of relative motion between the screen and backer parts, i.e., the rotation-based and the translation-based methods, are compared, and 2) difference between assembly and disassembly is analyzed. By using the maximum elastic energy in an assembly process, we show that 1) the rotation-based assembly motion has better robustness than the translation-based assembly motion in cellphone assembly tasks when we set the same initial position error, and 2) The rotation-based assembly method is more effective for





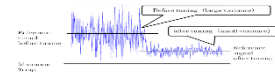
snap joint disassembly.

## **OS11 Educational Application Making Control Engineering Approach (5)**

### **OS11-1 Control Performance Assessment Method as Assessment of Programming Learning Achievement**

Yoshihiro Ohnishi (Ehime University, Japan)

It is an important problem how to estimate the learning achievement of the programming learning. However, the quantitative evaluation method according to the learning achievement is difficult. On the other hand, "work" of a control program influences the control performance of the plant by petrochemical industry, and to have an influence on the operation cost, Improvement of a program and am planning for productivity improvement are suggested by evaluating the control performance quantitatively. This research considers the using control performance assessment method for the achievement value of the programming learning.



The example of the good control result and the bad control result.

### **OS11-2 Practice of Control Education by Experiment using Robot**

Shinichi Imai, Hideto Matsui and Akira Yamada (Tokyo Gakugei University, Japan)

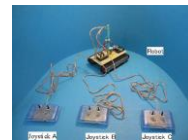
For students who attend lectures in control engineering, there are not many students whose understanding is insufficient. The reason why understanding is insufficient is to use many formulas. For that reason, various studies have been conducted on control education. Therefore, in this research, we propose a control education method using a robot so that interests and interests are given to students, practice lessons and verify its effectiveness.



### **OS11-3 Development of Support Teaching Material for Nurturing Cooperativity through Playing**

Kazuo Kawada (Hiroshima University, Japan)

I have been conducted educational activities utilizing robots corresponding to each stage from kindergartens to junior high schools. In this study, I propose and verify an educational material that supports collaborative operating by experiences related to people and things. Specifically, three children have a joystick for operating the robot. The robot does not move unless you manipulate the joystick at the same time. I developed the supporting teaching material that nurture cooperativeness through play.



### **OS11-4 On Methods for Teaching in Training for Keeping Tempo Constant in Music**

Hideyuki Tanaka and Keita Ueda (Hiroshima University, Japan)

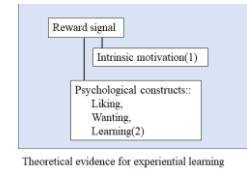
Ability of keeping rhythm is one of important factor in playing music. In this paper, the authors carry out experiments of training for keeping tempo constant in music. Experiments are carried out for experts and non-experts of music, and two methods for giving instructions are compared: The first method gives feedbacks by graphs and the other one by language. In order to ensure objectivity of the experiments, measurement data are collected by Processing, and changes of tempo etc. are analyzed by defining evaluate functions, where Scilab is used for computing the values of the evaluate functions. The experiments reveal that there are differences between experts and non-experts in giving instructions.



## OS11-5 Reinforcement Learning as a Theoretical Framework for Education

Masayasu Nagamatsu, Yuki Moriguchi (Hiroshima University, Japan)

Reinforcement Learning as a computational model of human learning, has recently become the subject of intensive investigation (Barto, A.G., 2005; Vigortio, C.M., 2010). Recent findings include: neural signature of hierarchical reinforcement learning, and multiple roles of reward signals in the human brain. These findings not only provide further theoretical evidences that complementary for traditional statistical inference in educational research, but also provide framework for model based design of educational processes. Types of evidence for education, and its relation to recent findings of human reinforcement learnings are discussed.

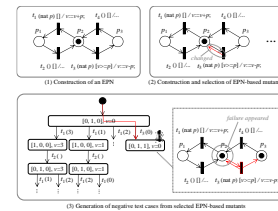


## OS12 Software Development Support Method (4)

### OS12-1 Negative Test Case Generation from an Extended Place/Transition Net-Based Mutants

Tomohiko Takagi<sup>1</sup>, Tetsuro Katayama<sup>2</sup> (<sup>1</sup>Kagawa University, <sup>2</sup>University of Miyazaki, Japan)

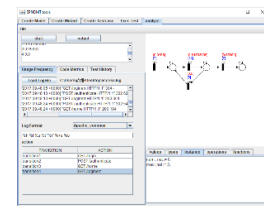
EPN (Extended Place/transition Net)-based mutants are formal behavioral models of software that contain intended failures. In negative testing, well-selected EPN-based mutants are used to generate negative test cases to confirm that software does not include serious or possible failures. However, the large state space and feasibility problem on EPNs cause the difficulty of generating the negative test cases from EPN-based mutants. The aim of our research is to construct a technique in which effective negative test cases for detection of intended failures are generated from EPN-based mutants. In this technique using ant colony optimization, ants heuristically search better paths (i.e., negative test cases) to find foods (i.e., intended failures) on a field (i.e., EPN-based mutant).



### OS12-2 Development of a Mutant Generation Tool Using a Genetic Algorithm for Extended Place/Transition Nets

Tomohiko Takagi, Shogo Morimoto (Kagawa University, Japan)

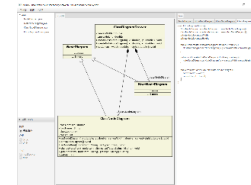
An EPN (Extended Place/transition Net) is used as a formal model that represents the behavior of software. When mutation testing is performed based on the EPN, failures are intentionally inserted into an original EPN (EPN that represents the expected behavior of software) in order to create mutant EPNs. A large number of higher-quality mutant EPNs are needed to expect the higher degree of accuracy for a mutation score, but the techniques to generate them have not been established. To address this problem, we construct an algorithm to generate mutant EPNs, and develop a tool to execute the algorithm. In this algorithm using a genetic algorithm, a set of mutant EPNs corresponds to a chromosome, and the fitness of each chromosome is evaluated based on an original EPN weighted by metrics.



### **OS12-3 Implementation of RETUSS to Ensure Traceability between Class Diagram in UML and Java Source Code in Real Time**

Keisuke Mori, Tetsuro Katayama, Yoshihiro Kita†, Hisaaki Yamaba, Kentaro Aburada, Naonobu Okazaki(University of Miyazaki. †Tokyo University of Technology, Japan)

It's increasing the importance of software in society, and it's becoming more important to secure the quality of software. Ensuring the traceability of deliverables is one of effective methods to secure the quality of software. It can verify that the requirements are reflected in the programs, and close the gap between the documents and the source code. But it has two problems: taking labor and time, and causing mistakes by human handling. This paper has implemented RETUSS (Real-time Ensure Traceability between UML and Source-code System) in order to solve the above two problems. RETUSS can ensure the traceability between Class diagram in UML and Java source code in real time.



### **OS12-4 Prototype of a Tool to Detect Specific Comments**

Satoshi Tanoue, Tetsuro Katayama Yoshihiro Kita†, Hisaaki Yamaba, Kentaro Aburada, Naonobu Okazaki(University of Miyazaki, †Tokyo University of Technology, Japan)

This paper has developed a prototype of a tool to detect specific comments. With the prototype, you can use regular expressions, describe patterns of detected strings in a configuration file, and then detect a specific comment. Even when other comments to be newly detected appears, it can flexibly be coped with by adding the pattern of the detected strings to the configuration file. The prototype was applied to projects with 5,000 LOC (Lines of Code) or more, and examined the precision and recall rate. As a result, the recall rate achieved 100% and the precision rate achieved 80%. By using the prototype, it is possible to detect comments which express tasks remaining in the source code and improper comments presented in the source code. Reducing their comments can improve understandability of the source code.

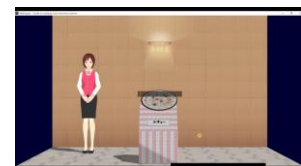


## **OS13 Human Interface and Artificial Intelligence (5)**

### **OS13-1 A Recipe Decision Support System with Recognition Ability Recoding Function Using Knowledge Information and Agent**

Keita Saito, Taro Asada, Yasunari Yoshitomi, Ryota Kato, and Masayoshi Tabuse (Kyoto Prefectural University, Japan)

We have developed a system for recipe recommendation with recognition ability recoding function using collaborative filtering and impression words. As a human interface, we have adopted an agent named as MMDAgent. In the proposed system, the first half recommendation process using collaborative filtering and the second half recommendation process using impression words of our previously proposed system are modified for recording the recognition ability of an elderly person as a user. The agent asks some questions to the user for finding out the initial decay on his/her recognition ability at the appropriate timings.



## OS13-2 A System for Analyzing Facial Expression and Verbal Response of a Person while Answering Interview Questions by Agent

Taro Asada<sup>1</sup>, Daichi Kogi<sup>2</sup>, Ryouichi Shimada<sup>3</sup>, Yasunari Yoshitomi<sup>1</sup>, and Masayoshi Tabuse<sup>1</sup>  
(<sup>1</sup> Kyoto Prefectural University, <sup>2</sup> S.Ten Nines Kyoto Co.,Ltd., <sup>3</sup> JFE Systems, Inc., Japan)

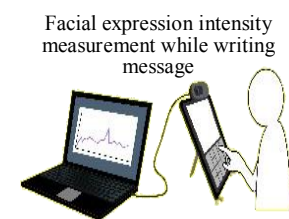
We have developed a system for analyzing facial expressions of a person while answering interview questions by agent. The image signal input from web camera while answering questions is analyzed by our real-time system. Moreover, the fundamental frequencies and the time to utterance of the answerer just after an interview question is terminated are measured for estimating the mental state of the answerer. In our previously developed system for analyzing facial expression of a person while speaking with another person, facial expression intensity could be affected by (1) a conversation topic, (2) a partner and (3) the facial expression of the partner. In this research, all of (1), (2) and (3) are fixed by using an agent's interview. The experimental result suggests the usability of this system for an interview where the facial expression and the verbal response are important factors.



## OS13-3 Facial Expression Analysis and its Visualization While Writing Messages

Yasunari Yoshitomi<sup>1</sup>, Taro Asada<sup>1</sup>, Kenta Mori<sup>2</sup>, Ryoichi Shimada<sup>3</sup>, Yuiko Yano<sup>1</sup>, and Masayoshi Tabuse<sup>1</sup>  
(<sup>1</sup> Kyoto Prefectural University, <sup>2</sup> Neyagawa City Hall, <sup>3</sup> JFE Systems, Inc., Japan)

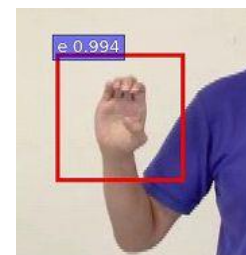
We have developed a real-time system for analysis of facial expressions and its visualization. The image signal input from web camera is analyzed by our real-time system using image processing software (OpenCV) and the previously proposed feature parameter (facial expression intensity). Our real-time system draws the graph expressing the facial expression intensity change using OpenCV. We applied the system for expressing emotion as a pictograph based on the facial expression intensity in writing messages. The experimental result suggests that our system can be useful for expressing emotion in writing messages.



## OS13-4 Recognition of Finger Spelling from Color Images Using Deep Learning

Yusuke Yamaguchi, Masayoshi Tabuse (Kyoto Prefectural University, Japan)

We have developed a system to recognize finger spelling in Japanese sign language using deep neural networks. As deep neural networks, we adopt Faster R-CNN. By defining an output class for each finger letter and learning the object detection network, it is possible to output where the finger letter exists in the input image. This method does not require depth cameras, magnetic sensors, or other special equipment when used. Furthermore, this does not require preprocessing that extracts the hand region using human skin colored regions and color gloves used in other methods using color images. We synthesized a training data set by processing images taken with Kinect. As the test data, we input images of performing finger letters into the trained network and check the score of the output area and class.



## OS13-5 Recognition of Texting While Walking Using Convolutional Neural Networks

Junpei Miyachi, Masayoshi Tabuse (Kyoto Prefectural University, Japan)

The number of people who operate a smartphone while walking increases with the spread of smartphones. Pedestrians who are texting while walking decrease attention to their surrounding environment. This is the cause of falling from station's platform or bumping into someone in public areas such as railway stations. The purpose of this study is to detect pedestrians who operate a smartphone using surveillance camera for the support of accident preventions in railways. The pedestrians have the same features of posture such as hand position and facial direction. In order to recognize the posture, we employ convolutional neural networks (CNN), which has improved results in various fields in recent years. In this paper, we propose the method of the texting while walking recognition using CNN. We show the classification results of a pedestrian who is texting while walking.



## OS14 Advanced Technology on Sensing Technology, Devices, Application (6) OS14-1 A Study on the Lumbar Burden Evaluation of Work using One Smartphone

Mizuki Maiguma, Hiroki Tamura, Koichi Tanno (University of Miyazaki, Japan)

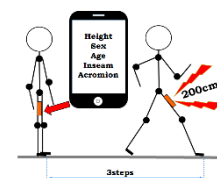
In this paper, we propose the human lumbar burden evaluation method and state estimation system using smartphone and its application to agricultural work. The proposed system consists of two functions, 1) "State estimation" has a function of estimating posture (Stand up, Sit down, Crouch, Walk, etc.) of the subject. 2) "Lumbar burden estimation" has a function to estimate the angle of waist from the angle of the subject's upper body and calculate the lumbar burden in combination with other parameters. The aim of this paper is to get the data of the subject's work status in the agricultural field in simple manner and quasi-real time and help improve the agricultural work efficiency by constructing the agricultural work burden evaluation system using smartphone. In this paper, we show on the experimental results of two functions and the evaluation of the actual agricultural work.



## OS14-2 A Study on High Accuracy Stride Estimation on Smartphone Combining Acceleration Sensor and Gyro Sensor

Shunta Nonaka, Hiroki Tamura, Koichi Tanno (University of Miyazaki, Japan)

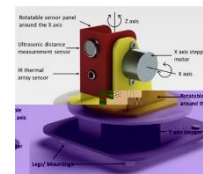
The stride is an important parameter in human motion analysis and has been extensively studied by many researchers. This paper focuses on smartphones that are popular in the world, regardless of the measurement environment. In previous research, the stride estimation using the acceleration sensor or the gyro sensor mounted on the smartphone had been studied. However, the estimation accuracy of stride has an error rate of about over 10%. In this paper, we propose a highly accurate stride estimation method using stride correction parameter obtained from cross section movement in addition to conventional sagittal surface stride using acceleration sensor and gyro sensor mounted on smartphone. From the results, the error rate of our proposed method with the stride estimated by kinect sensor (RGB-D sensor) as the true value was about 6%, making it possible to estimate the stride with high accuracy.



### OS14-3 Development of Multi-Sensory Smart Objects Tracking Module for Mobile Robot Platforms

B. A. D. J. C. K. Basnayake, Y.W.R.Amarasinghe (University of Moratuwa, Sri Lanka)

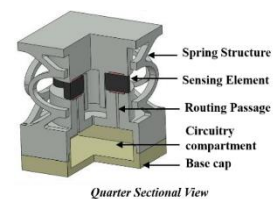
In the mobile robot systems, the ability to navigate in its environment is important. Often, the surrounding environment is dynamic and unknown. Object tracking is a sensing system employed with most of the robotics navigation systems. These sensors can provide real-time information related to the obstacles and target detections. Living object identification and positioning are difficult compared with stationary obstacles identification, because of their behaviors. But it is important for robotic platforms which operate in living premises in order to perform collision-free navigation and localization features. Therefore, we have developed infrared thermal image based smart living object tracking system which capable of detecting and positioning movable and stationary living object in a certain range. The system mainly consists of non contact thermal array sensor and sonar sensor that mounted in the 2-axes rotatable platform. These sensors capture the surface temperature, directions to the heated objects and related distance and later the captured information is analyzed by the filtering and detection algorithms. Based on the above information, the system will generate real-time point cloud related to the living objects and fix-obstacles placed in the environment. Developed system will use in navigation, human following and obstacles avoiding applications in mobile robot systems.



### OS14-4 Design and Development of a Conductive Polymer Based 3D – Printed Tactile Sensor with Square Type Spring Structure

W.H.P. Sampath, A.H.T.E. De Silva, Y.W.R. Amarasinghe (University of Moratuwa, Sri Lanka)

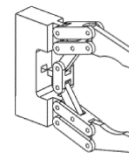
Industrial Robot Manipulators used in the industry lacks force sensory feedback relating to the force exerted on the grabbing object by the artificial manipulator. In most of the manipulators, the degree of controlling and handling only done by identifying the presence and position of objects using optical proximity sensors. However, it is possible to enhance the controlling of the artificial arm by introducing a force sensory feedback unit. In this research, design, development and testing of a force feedback system were discussed using a novel conductive polymer based 2x2 sensing element array incorporated to a novel 3D printed square type spring structure to provide the user with closed-loop controlling. Arch was featured by a combination of two – two-point splines where the gradient of starting and end points are zero. The incorporated conductive polymer is a silicone rubber based polymer which has enhancements by silica and carbon black, with Silane as the coupling agent. The spring structure stated in this paper has been designed for force scaling purpose and numerically analyzed using COMSOL Multiphysics prior to the fabrication to avoid mechanical failures. The inherent problems in conductive polymer piezo-resistive characteristics such as operation range deviation w.r.t. chemical composition could also be overcome by this design approach.



## OS14-5 Design and Development of a Shape Memory Alloy Spring Actuated Gripper for Minimally Invasive Surgeries

Roshan T.A.U, Amarasinghe Y.W.R, Dayananda N.W.N. (University of Moratuwa, Sri Lanka)

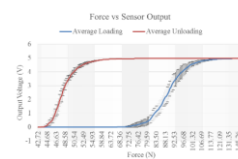
MIS is a novel and emerging surgical procedure in the medical surgery field. Miniaturization of the tools and the actuators used in MIS is important. The properties such as high energy density, excellent biocompatibility, corrosion resistance, miniaturization capability etc. highlights the selection of SMA as the actuation material. Currently there were several studies available about SMA powered grippers, but in this study, the main intension is to preserve simplicity in the design and controlling stage. A kinematic and dynamic analysis was performed in the software based environment using MATLAB and COMSOL Multiphysics respectively. In the development stage the structural components of the gripper is made by 3D printing. The SMA spring is made out of Nitinol (55% Ti and 45% Ni) wire with 0.5 mm diameter, fixed as a spring (6 mm in Dia.) and aged in a Muffle furnace at 400 C for 15 mins. For the heating of SMA material electric current was used and joule heating was enabled the actuation. This SMA spring actuator is combined with a biasing spring which is made out of normal steel in order to achieve the required opening and closing action of the gripper jaws. Among the different biasing methods, this was the suitable design as this gripper operates on the opening mode which is the best way to avoid SMA overheating. Temperature measurement and a Gripper jaw displacement measurement was taken in order to discuss the factors influencing gripper performance. As well the tests were conducted to match the best compromise between influence of cooling method, SMA activation current, and operation frequency. The controlling was done by Pulse Width Modulation (PWM) method as it significantly reduces the energy consumption and robust to the external disturbances.



## OS14-6 Design and Development of Quantum Tunneling Composite based Tactile Sensors

T.D.I. Udayanga, D.A.M.R. Fernando, H.L.P.L. Chaturanga, B.A.D.J.C.K. Basnayake, Y.W.R. Amarasinghe (University of Moratuwa, Sri Lanka)

Tactile Sensing is measuring tactile parameters with the aid of physical touch. Currently, specifically regarding the robotics and biomedical fields, research were limited by having lack of tactile feedback systems. Hence, tactile sensing has come to the spotlight of research and has developed so considerably when comparing with the past decades. Also application areas of tactile sensing has been expanded as new fields of applications has emerged recently regarding tactile sensing. In this study, a miniaturized novel enclosed tactile sensor was designed and developed using Quantum Tunneling Composite (QTC™), which is a conductive polymer composite, as the sensing element. An enclosed novel structure was proposed so that the sensing element and spring will be omitted from the environmental effects. Proposed sensor structure was analysed and manufactured. Experiments were carried out and results shows that the sensitivity of this developed tactile sensor to be 0.02 V/N and repeatability of  $\pm 3$  N.

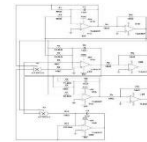


## OS15 System and Control (11)

### OS15-1 Analog circuit design of a novel 4D chaotic system

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

In this paper, a novel four-dimensional (4D) autonomous chaotic system is reviewed, and its corresponding new analog circuit is presented based on the modified module-based approach to chaotic circuit design. The chaotic phase portraits of the new circuit are given to illustrate the good qualitative agreement between the numerical simulation and the experimental realization.



### OS15-2 A method of end-to-end self-understanding of Chinese paper-dictionaries

Zhijian Lv (Beijing Institute of Science and Technology Information (BISTI), P.R.China),

Yizhun Peng (Tianjin University of Science and Technology, P.R.China)

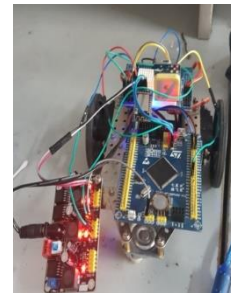
This paper introduces a method of end-to-end self-understanding of Chinese paper-dictionaries. In this method, a page of Chinese paper-dictionaries is scanned into an electronic image. And then the electronic image is preprocessed, including un-distortion, side scrapping, binarization, and so on. Finally, using an end-to end deep learning method, the pre-processed electronic image is intelligently segmented, text recognized, and context understood. Our method has been applied to self-understand a serial of Chinese paper-dictionaries, which have more than 13000 pages and 2.1 millions of phrases. And its correct rate of self-understanding of Chinese phrases is more than 99.5%. Its performance has proved it's availability.



### OS15-3 A multi-robot rescuing system

Huailin Zhao, Zheng Wu, Xiaoxing Wang (Shanghai Institute of Technology, China)

The study subject is a multi-agent system consisting of a few mobile robots. In the system, each robot collaborates with the other ones, and they all work together to complete the disaster rescuing tasks such as the fire fighting. The multi-agent system control theory is applied in the system, where each mobile robot is an independent intelligent individual. The robots communicate wirelessly among them. Even though there is trouble with the individual robots, the others will collaborate among them in time and adjust their control policy to ensure the system itself working normally and complete the disaster rescuing task. In the system, an upper computer is designed for supervising, human-machine interfacing and being the transferring station of the data exchange. The experiment shows that the multi-robot distributed control system based on WIFI, GPS and INS information is able to achieve the consistent action such as rescue gathering.

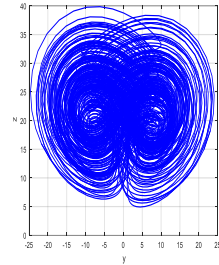




## OS15-4 Dynamic analysis and FPGA implementation of A novel hyper-chaotic system with one equilibrium point

Shanfeng Wang, Hongyan Jia, Zhiqiang Guo  
(Tianjin University of Science and Technology, China)

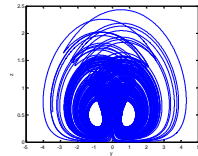
In recent decades, the study on the chaotic system and hyper-chaotic system attracts more and more interest with developing of non-linear subjects. This paper firstly presents dynamic numerical analysis of a novel hyper-chaotic system with one equilibrium, which includes the stability analysis of equilibrium point, bifurcation diagram, Lyapunov exponent and so on. Then, based on the method of converting continuous-time differential equation to discrete-time differential equation, FPGA(Field Programmable Gate Array) implementation for the novel hyper-chaotic system is finished, and the results from FPGA implementation are consistent with those from numerical analysis. The work in this paper may provide a method for the application of the hyper-chaotic system.



## OS15-5 Analysis and circuit implementation for a new fractional-order chaotic system

Zhiqiang Guo, Hongyan Jia, Shanfeng Wang  
(Tianjin University of Science and Technology, China)

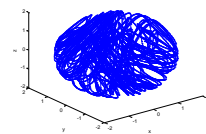
This paper firstly recommends a new fractional-order chaotic system, only including six terms and three multipliers, which is different from the Lorenz and other existing fractional-order systems. Then some numerical analyses including the phase trajectory diagrams, Lyapunov exponents diagrams and bifurcation diagrams are given to investigate the different dynamical characteristics of the chaotic system. At last, an analog circuit is designed to implement the system, further verify the effectiveness of the fractional-order chaotic system in practical application.



## OS15-6 Application of a conservative chaotic system in image encryption

Shilong Liu, Mei Zhang, Wei Xue(Tianjin University of Science and Technology, China)

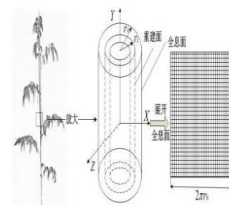
The dynamic behaviors of a new conservative system are analyzed based on its phase trajectory, Poincaré section, Lyapunov spectrum. On this basis, the conservative system is applied to digital image encryption and the security performance of the algorithm is analyzed and verified. The results show that compared with the dissipative systems, the chaotic attractor in conservative system is not apparent. The conservative system also has the characteristics of pseudo randomness and similar noise, whose safety is high, and is not easy to be cracked. Therefore, the conservative system has a quite high research value and application prospect.



## OS15-7 Study of plant disease detection based on near-field acoustic holography

Jiangfan Wang, Xiuqing Wang (Tianjin University of Science & Technology, China)

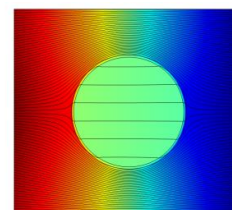
In the process of crop cultivation, pests and diseases on crop growth and development, yield and quality of the most obvious. To control pests and diseases quickly and effectively, real-time understanding of the growth of crops to the disease based on reasonable and accurate spraying of pesticides is particularly important. The key to the implementation of precision spraying is the accurate positioning of crop diseases. In this paper, the main stem of the plant was taken as the object of study. Based on the near-field acoustic holography, the sound field model of the disease was established and the three-dimensional spatial sound field was reconstructed by the algorithm to analyze the sound field of the sound source. Identify the sound source signal of the plant, locate the position of the sound source, make effective judgment on the damage status of the plant, determine the disease condition, and establish the optimal control strategy.



## OS15-8 Simulation of Cell Dielectric Properties Based on COMSOL

Shudong Li, Xiaoyan Chen, Fengze Han (Tianjin University of Science & Technology, China)

The dielectric properties of single cell can be observed by injecting a low amplitude current at different frequencies (1MHz~200MHz). The simulation work is taken on the software platform named COMSOL Multiphysics. The electric field and the cell model is created with prior conductivity, the extracellular and the intracellular fluid is 1 S/m and the membrane is  $1 \times 10^{-5}$  S/m separately. By simulation, it's verified that at low frequencies, the region of interest (ROI) behaves the conductivity characteristic as the electrical signal cannot pass through the cell membrane due its capacitor properties. With the excitation frequency increasing, the ROI behaves more permittivity characteristic as the current flowing through the cell membrane more and the current density increases. The research of the cell dielectric property provides an auxiliary method to diagnose the status of the cell.

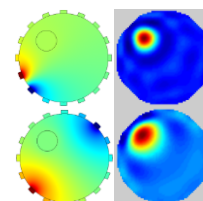


## OS15-9 Research on the method of electrical impedance tomography based on conjugate gradient iterative algorithm

Yuanli Yue<sup>1</sup>, Xiaoyan Chen<sup>2</sup>, Ze Liu<sup>1</sup>, Fengzhi Dai<sup>2</sup>

(<sup>1</sup> Beijing Jiaotong University, China. <sup>2</sup> Tianjin University of Science and Technology, China)

Electrical impedance tomography is a new technology of medical imaging ,that can be used to detect the real time internal electrical impedance. This article is doing research on the method of electrical impedance tomography by using conjugate gradient iterative algorithm. Using the finite element analysis software Comsol to make a two-dimensional modeling, and make the target circular field with 16 electrodes is established. And the empty field and full field stimulation of different excitation current analysis, there are relatively adjacent to motivate and encourage .By using Matlab to make tomography reconstruction, using two different reconstruction algorithms. After the reconstruction of the graphic ,using a variety of evaluation of the graphic image reconstruction and numerical analysis, such as the use of the correlation coefficient, and the similarity relative error evaluation.

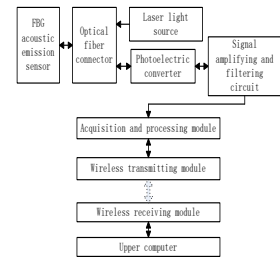


## OS15-10 Research on acoustic emission wireless detection system

Xiuqing Wang<sup>1</sup>, Yang Li<sup>2</sup>, Qing Liu<sup>1</sup>, Jiming Zhao<sup>1</sup>

(<sup>1</sup> Tianjin University of Science & Technology, China; <sup>2</sup> TEXAS A and M University, U.S.A)

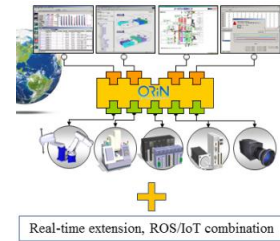
A Fiber Bragg grating (FBG) acoustic emission wireless sensing system was presented in this paper. The acoustic emission signal source was simulated by the method of breaking the automatic pencil lead core, the signals collected by the sensor were processed by photoelectric conversion, amplification, filtering and so on. The system adopted waveform feature extraction method, through wireless sensor network, characteristic values uploaded to the host computer software. A comparative experiment of piezoelectric ceramic acoustic emission sensing system and FBG acoustic emission sensing system was carried out. It can be seen from the results that the acoustic emission signal waveforms and characteristic parameters collected by the two sensing systems were different. These differences were related to the inherent structural characteristics of the sensor itself. The upper and lower surfaces of piezoelectric ceramic sensors can cause the superposition of acoustic emission signals, however, FBG acoustic emission sensor does not exist this problem. Therefore, the waveform collected by FBG sensor does not produce distortion, which is the advantage of FBG acoustic emission sensing system than piezoelectric ceramic acoustic emission sensing system in principle.



## OS15-11 ORiN PAC (PC based Automation Controller)

Toshihiro Inukai (DENSO WAVE INC., Japan)

This paper introduces application examples of ORiN PAC (PC based control system utilizing ORiN as middleware). The manufacturing system is composed of huge kinds of devices, and it is necessary to make device programs for controlling these devices in cooperation. The mfg. system becomes increasingly complicated, and along with the increase in programming cost, the improvement of programing efficiency became a big issue. In this paper, we propose ORiN PAC as a solution to realize "one software architecture" applicable from small scale to large scale mfg. systems. This solution has been used in the real factories in the world (not just a demo), and it will be quite important also for realizing "Industrie 4.0" world. *ORiN: Open Resource interface for the Network*

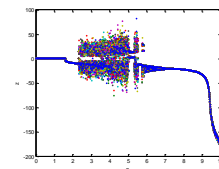


## OS16 Recognition and Control (9)

### OS16-1 Research on the synchronization and circuit realization of a four-wing chaotic system

Yiqiao Qin, Fengzhi Dai, Yuxing Ouyang, Qijia Kang, Ce Bian, Baochang Wei, Runhua Mao, Shengbiao Chang (Tianjin University of Science & Technology, China)

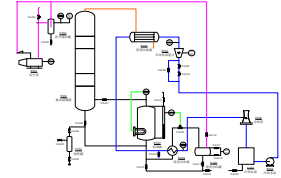
This paper introduces a three-dimensional four-wing chaotic system and the system is analyzed and circuit verified. The paper adopts two synchronous control strategies to control the three - dimensional four-wing chaotic system. One is the feedback synchronization controller based on the observer, and the other is the synchronization controller based on theory of stability. The feasibility of these two methods is proved by analyzing the numerical data and the circuit implementation. On this basis, we conducted signal encryption research. The results verify the feasibility of the synchronous design and encryption design.



## OS16-2 Design of control system for reboiling part of distillation process

Lingran An, Fengzhi Dai, Yujie Yan, Yuxing Ouyang, Zhongyong Ye, Xia Jin, Baochang Wei  
(Tianjin University of Science and Technology, China)

This paper selects the control system for re-boiling part of distillation process for major research. The control scheme is determined according to the influence of the relevant parameters on the distillation process. The hardware part uses the Siemens S7-200 series PLC as the main control machine. The lower position machine uses STEP 7-Micro / WIN programming software, and writes the control program through the ladder diagram. It combines the PID algorithm and single closed-loop control to complete the field data collection and processing and communication with the host computer. The host computer uses the configuration king named kingview6.55 monitoring system software to complete the automatic control system monitoring.



## OS16-3 Research on intelligent control system based on machine vision

Ce Bian<sup>1</sup>, Fengzhi Dai<sup>1</sup>, Yuxing Ouyang<sup>1</sup>, Yiqiao Qin<sup>1</sup>, Baochang Wei<sup>1</sup>, Runhua Mao<sup>1</sup>, Meili Li<sup>2</sup>  
(<sup>1</sup>Tianjin University of Science and Technology, China; <sup>2</sup> China University of Petroleum, China)

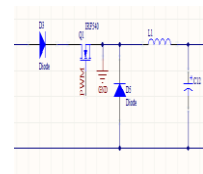
Surface Mount System is a device which function is move attachment head to make surface mount components accurately placed on the PCB pad. SMT has machine vision system and intelligent control system compose. The machine vision system through the camera to capture images of components. Then the software for image processing and camera calibration problem is one of key issue of machine vision research. Ultimately determine the component coordinate axes. The mainly function of intelligent control system is that controller drives X, Y, Z, R each axis motor to carry out the intelligent logic movement and controls the digital signal to carry on the logical response. Data exchange between Machine vision and the intelligent control part base on upper computer. On this basis, the position of the component on the PCB can be identified by the intelligent operation of machine vision.



## OS16-4 Development of NC power based on Buck circuit

Yuxing Ouyang, Fengzhi Dai, Runhua Mao, Ce Bian, Baochang Wei, Yiqiao Qin, Shengbiao Chang, Qijia Kang (Tianjin University of Science and Technology, China)

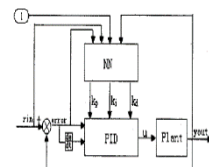
This paper develops a kind of power-supply module which uses digital control and buck circuit. The module can convert 220v alternating current into 0-30v direct current. In the aspect of circuit design, it is mainly AC- DC, DC-DC conversion circuit and SCM minimum system circuit. In the aspect of control circuit, for feedback signal of current sensor, the power-supply module can obtain average value by multiple means and remove the mutation value.



## OS16-5 Simulation of PID temperature control system based on neural network

Yujie Yan, Fengzhi Dai, Lingran An, Yuxing Ouyang, Zhongyong Ye, Xia Jin, Ce Bian  
(Tianjin University of Science and Technology, China)

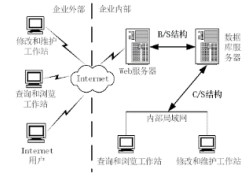
The system designed in this paper is a combination of neural network and PID control. BP neural network has a great advantage in solving the control of nonlinear and uncertain systems. It can use the steepest descent learning method to adjust the threshold and weight values by back propagation. The ultimate goal is to adjust the PID controller adjustable parameters by the neural network learning algorithm. Using MATLAB software to simulate, the results show that the system has a strong following performance and a high anti-interference ability. Experiments show that the PID temperature control system based on neural network has some practicality.



## OS16-6 Design and research of real-time material management system based on production process

Baochang Wei, Fengzhi Dai, Yuxing Ouyang, Haifang Man, Yiqiao Qin, Runhua Mao, Ce Bian  
(Tianjin University of Science and Technology, China)

The paper primarily introduces the real-time material management system in the course of machinery production. This system is developed and designed using C# language and SQL2008 database, using C/S and B/S mixed mode, the C# language-related programming skill and database information together, through the C/S and B/S architecture for network communication, the database Server-related production material information sharing management system feedback to the specific user, thus enhancing the production efficiency.



## OS16-7 Research on the balance control of the inverted pendulum

Zhongyong Ye, Fengzhi Dai, Yuxin Ouyang, Yujie Yan, Xia Jin, Lingran An, Hongtao Zhang  
(Tianjin University of Science and Technology, China)

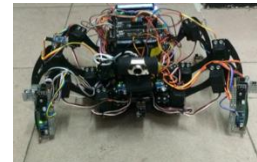
There are many strategies in the field of automatic control to achieve stable control of the inverted pendulum. The typical control strategy is PID control algorithm. But PID controller can only point to point control, so this paper proposes an improved strategy. This paper adopts multi-loop PID strategy to realize the stability control of inverted pendulum. Through simulation analysis, this strategy is more efficient than PID control algorithm.



## OS16-8 Design of intelligent saving robot based on six-legged robot

Xinyu Zhang, Xiaokun Lin, Fengzhi Dai (Tianjin University of Science & Technology, China)

In recent years, along with the humanity to have high mobility in the complex environment, and high reliability, and easy to expand increasingly urgent demand for mobile platform, plus multi legged robot research and algorithm improvement of gait, scientists have considerable research to the application of biped multi legged robot, biped robot is in the past wheel type or track system, the motion is confined to the plane, unable to overcome many mountain disaster or rough terrain. Therefore, a rescue robot based on six legged robots came into being. This text robot can use mobile phone app to switch robot mode or remote control robot through Bluetooth or wireless mode. And the robot can switch the automatic mode and switch the automatic mode, and the robot can realize obstacle jumping through sensors to identify the types of obstacles. And the robot comes with an electronic compass, a camera and a gyroscope, which can intelligently record the path of travel and automatically return to its starting position along the source path.



## OS16-9 Research on multi-object recognition algorithm based on video

Yong Hou, Runhua Mao, Yuxing Ouyang, Ce Bian, Binhu Song, Baochang Wei, Yiqiao Qin, Shengbiao Chang, Fengzhi Dai (Tianjin University of Science and Technology, China)

This paper mainly studies and improves the detection and tracking algorithm of the robot fish video and presents a background extraction method based on HSV color space. This method is more efficient than the background extraction method of RGB color space, which improves the recognition, anti-jamming ability and robustness. Through the experiment, it has a strong adaptability to external influences such as background water surface fluctuation, reflective, light change shadow.

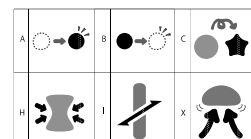


## OS17 Automated content generation and cognitive content generation (7)

### OS17-1 Reinventing the Flavor Wheel

Hiroki Fukushima (Kyushu Women's University, Japan)

In this paper, the author proposes a new type of flavor wheels. Flavor wheel is made for the tasting professional as like sommeliers, in order to visualize the tasting words in a hierarchical way. An ordinary flavor wheel has two or three hierarchy; abstract genres (e.g. “floral”, “fruit”) are set in the inner circle, and concrete words (e.g. “jasmine”, “apple”) are set in the outer part. The hierarchical structure can be rewritten into a tree structure; hence the wheel shape needs to have its advantage in comparison to the tree structure. The author points out mainly two drawbacks of ordinal flavor wheel: 1) the whole area of the circle is evenly split by the number of the total words. And 2) the lack of the relationships among the words and genres. This paper aims to overcome these two drawbacks and propose a new type of flavor wheels.

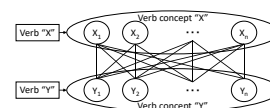


### OS17-2 Acquiring Short Scripts and Setting a Case Frame in each Acquired Script: Toward Random Story Generation

Jumpei Ono (Graduate School of Iwate Prefectural University, Japan),

Takashi Ogata (Iwate Prefectural University, Japan)

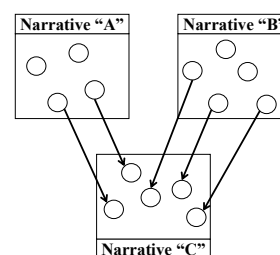
The integrated narrative generation system, that the authors have developed, generates a story to translate the story into the surface representation. In the story generation process, the INGS uses narrative knowledge that was automatically acquired from existing narrative works. This paper presents a method to acquire short scripts, which are a kind of narrative knowledge, from existing works in Aozora Bunko for the story generation. This paper presents a mechanism to generate random story-like event sequences by using 23,751,142 bi-gram scripts acquired based on the method proposed below. The authors aim to use the scripts generated by the method as a first set to be revised through the next learning process.



### OS17-3 A Method of *Naimaze* of Narratives Based on Kabuki Analyses and Propp's Move Techniques for an Automated Narrative Generation System

Takashi Ogata (Iwate Prefectural University, Japan)

*Naimaze* in *kabuki* has been known as a narrative creation method for combining components in existing *kabuki* works or the other genres' narratives to make a new work. Various components, such as story, plot, character, place, are used as the components in *naimaze*. The author aims to use the *naimaze* method in an automated narrative generation system that we have been developing, namely the Integrated Narrative Generation System (INGS). In this paper, we present an approach to design the narrative techniques of *naimaze* in the INGS by applying the way for combining “move” in V. Propp's narratological study, “morphology of folktales.” A move by Propp means a narrative macro level unit or a kind of sequence that is composed of several “functions” and he showed various ways that combine several moves to construct an entire narrative structure. This paper shows ideas of a *naimaze* techniques and the implementation of experimental programs based on various kabuki analyses and the Propp's move method.



## OS17-4 Narratology goes to Creativity ---Cognitive Content Generation

Akinori Abe (Chiba University, Japan)

In the previous studies, I discussed the creativity in IMDJ (Innovators Marketplace on Data Jacket). The Innovation Game seems a game where a new production will be obtained during the combination of various techniques, materials and previous products. Accordingly I discussed IMDJ performance from the perspective of abduction. In addition, more important matter is the effect of communication among participants which is plays a significant role in creativity. That is, for creativity, important matters are "action of a novel relational product" and "the role of interaction and collaboration with other individuals." Then I discussed the role of comfortable communication (narratology) by robots in the creative situation as well as usual situation. In this paper, I will discuss the role of narratology which is based on the cognitive content generation in the creative task.



## OS17-5 A Framework for Haiku Generation from a Narrative

Takuya Ito, Takashi Ogata (Iwate Prefectural University, Japan)

In this paper, the authors propose a framework for the mutual transformation between a narrative and haiku-like sentences. In particular, this paper shows a method for generating haiku-like sentences from a narrative fragment. The authors have been developing an integrated narrative generation system that automatically generates narratives. This paper aims to combine to this mechanism relating to haiku with the system in the future. Basic elements for generating a narrative and a haiku-like sentence are commonly the selection, arrangement, and modification of the elements. In order to generate haiku-like sentences from a narrative, the proposed method selects particular elements from a narrative and arranges them according to the form of a haiku-like sentence. Further it gives variations to the haiku-like sentence. In this paper, the authors show several forms for haiku-like sentence generation to experimentally generate haiku-like sentences from a narrative.



## OS17-6 Cognitive content generation for healthy ageing

Yuki Hayashi (Chiba University, Japan)

In the previous studies, we discussed some problems in super-ageing society and how to support older people. Recently, healthy ageing has been an important concept to decrease risk of disease, care independence or any other troubles. For example, WHO has recommended healthy lifestyle to younger and middle-aged people. In addition, a concept "ME-BYO" which was originally generated in oriental medicine has been accepted around the world. Accordingly to figure out the best strategy for treating older people in Japan has been a challenging problem. However, there remains some matters, thus, how to evaluate the state of healthy and how to provide personalized approaches for healthy ageing. In this paper, we'll discuss the evaluation of healthy state and content generation for personalized approaches for healthy ageing.

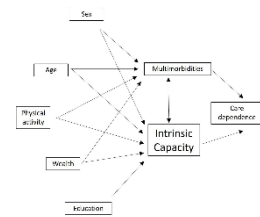
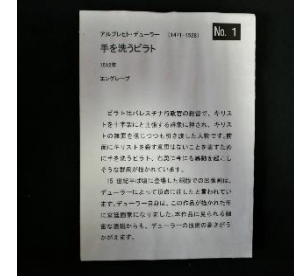


Fig. Structure Equation Modeling of the

## OS17-7 Museum Visitors' Behavioural Change Caused by Captions

Kotone Tadaki (Chiba University, Japan)

In museums, especially in art museum, there are several visitors only reading captions (short explanation displayed next to artwork in exhibition room) without seeing any artworks. When we regard caption as a Shikake which is aiming to make visitors see artwork, each caption already has a physical trigger. Since caption and artwork are usually displayed on the same wall so that visitors can easily see both caption and artwork in the same time. Although there are physical trigger, captions are not functioning as expected. In this paper, we try to add psychological triggers by adding some features to captions. The presence of change in how they see artwork was measured by time spent to see artworks, movement from caption to artwork, and participants' impressions to each artworks and each captions. The result of the experiment shows museum visitor's generation of story based on information provided by captions and artworks.

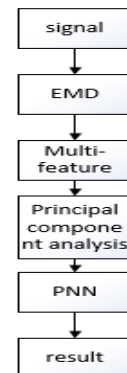


## OS18 Intelligent Control (5)

### OS18-1 Rolling Bearings Fault Diagnosis Method using EMD Decomposition and Probabilistic Neural Network

Caixia Gao, Tong Wu, Ziyi Fu (Henan Polytechnic University, China)

Aiming at the problem that the vibration signal of the early fault is weak, the fault information is difficult to be extracted, the accuracy of single fault feature identification is low, and the fault feature is redundant. A fault diagnosis method of rolling bearing combined with empirical mode decomposition (EMD), multi - feature parameter principal component analysis (PCA) and probabilistic neural network (PNN) is proposed. First, the EMD is used to decompose the vibration signal into the sum of several IMF components to achieve the smoothness of the non-stationary signal. Since the bearing fault information is concentrated in the high frequency band, the first five IMF vectors of high frequency are used to obtain their energy, kurtosis and skewness characteristics to form the eigenvector. Finally, the feature vector group is de-redundant by principal component analysis, and it is put into PNN for fault recognition. The simulation results are compared with the intrinsic mode energy method of EMD. It is concluded that EMD-based multi-feature parameter principal component analysis has higher accuracy. At the same time, the relationship between the number of principal components of the method and the correctness of diagnosis is analyzed.



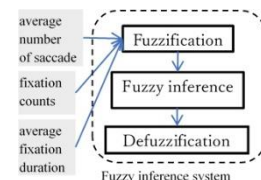
Troubleshooting flowchart

## OS18-2 Detection of Dangerous Driving Behavior via Fuzzy Inference System

Shangzheng Liu<sup>1</sup>, Qinghui Zhu<sup>1</sup>, Fuzhong Wang<sup>2</sup>

(<sup>1</sup>Nanyang Institute of Technology, P.R. China, <sup>2</sup>Henan Polytechnic University, P.R. China)

Aiming at identifying fatigue driving and drink driving, a new detection scheme for the analysis of dangerous driving behavior was proposed in this paper. First, three eye movement characteristics, average number of saccade, average fixation duration, and fixation counts. Second, membership functions and fuzzy inference system (FIS) were established. Finally, fatigue driving and drink driving were identified by the proposed FIS. In the Matlab/Simulink simulation environment, the simulation system was built. The simulation is carried out to verify the effectiveness of the proposed FIS.

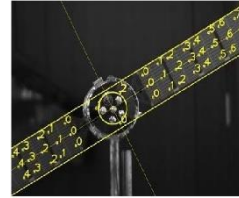




## OS18-3 Feature Points Designing and Matching for the Target Spacecraft in the Final Approaching Phase of Rendezvous and Docking

Wenjing Pei, Yingmin Jia (Beihang University (BUAA), China)

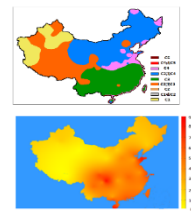
Motion information of the target spacecraft can be calculated according coordinate change of feature points based on the motion control model. In order to extract motion information including velocity, location, attitude of the target spacecraft in the final approaching phase of rendezvous and docking, feature points marking and matching for the target spacecraft is an essential step. In this paper, feature points are designed on two solar panels and the fore-end cabin in the target spacecraft by using three baselines and the feature circle methods. Thus 51 feature points can be obtained. Feature points matches are obtain by applying an improved feature points matching strategy to feature points which have been designed. Experimental results shows that running speed is improved greatly and high accuracy is maintain.



## OS18-4 Construction and Visualization of Atmospheric Environment Data Map

Dongmei Fu, Gaoyuan Wang, Chao Wu, Mengchen Cui  
(University of Science and Technology Beijing, China)

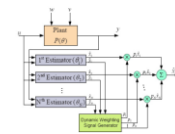
This paper includes two points: 1, how build the China's map of the atmospheric corrosion level, according to the ISO9223-2012 Two methods are used. One is the inverse distance weighting method, and other is the improved inverse distance weighting based on density. 2, how build the China's map of carbon steel corrosion rate, according to sparse carbon steel corrosion data. Two methods are used. One is a multi-faceted function method, and other is an improved multi-faceted function method.



## OS18-5 Multiple-Model Adaptive Estimation with New Weighting Algorithm

Weicun Zhang (University of Science and Technology, China)

This paper presents a new scheme of weighted multiple-model adaptive estimation for a discrete-time stochastic dynamic system with large parameters uncertainty, in which the classical weighting algorithm is replaced by a new weighting algorithm to reduce the calculation burden and to relax the convergence conditions. Simulation results verified the effectiveness of the proposed scheme.

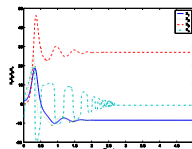


## OS19 Advanced Control (5)

### OS19-1 Revisit Constrained Control of Chaos

Yunzhong Song, Ziyi Fu and Fuzhong Wang (Henan Polytechnic University, P.R.China)

Only two conditions were considered in paper titled as constrained control of chaos in [Y.-C. Tian, M. O. Tade, and D. Levy, Physics Letters A296 (2002) 87], and thereafter a special problem was investigated and the corresponding solving strategy was provided in paper titled as some comments on constrained control of chaos appeared in [Y. Z. Song, G. Z. Zhao, and D. L. Qi, Physics Letters A359 (2006) 624], in this Letter, a soft control scheme which is chattering free dominated just by single flexible factor is suggested to improve the already existing conclusions, and simulation results indicate the validity of our project.

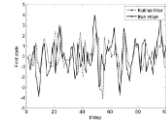


Control results of  $u^+$  with  $M=3$ ,  
 $\alpha = 1/4$

## OS19-2 Research on Filtering for Random Data Packet Dropouts and Delays in Wireless Sensor Networks

Sumin Han, Fuzhong Wang (Henan Polytechnic University, P.R.China)

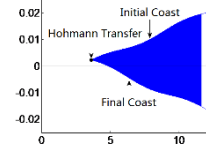
A wireless transmission data model is proposed to solve the problem of packet loss and delay in data transmission of wireless sensor network data transmission system. Based on the minimum variance estimation, the optimal fusion filter and cross covariance matrix are derived. The effectiveness of the system is verified by a simulation example.



## OS19-3 Optimal Hohmann-Type Impulsive Ellipse-to-Ellipse Coplanar Rendezvous

Xiwen Tian, Yingmin Jia (Beihang University (BUAA), China)

This paper devotes to the problem of ellipse-to-ellipse coplanar rendezvous in low eccentricities, where the solution and distribution of Hohmann-type optimal impulsive rendezvous are investigated. The process of ellipse-to-ellipse coplanar rendezvous is described in the reference frame built in a circular orbit near two spacecrafts. Based on which, the analytical relation between the initial states and rendezvous time are derived for Hohmann-type, and the optimal impulse amplitudes are given thereupon. By selecting rendezvous time as the X-coordinate and special phase angle as Y-coordinate, the distribution boundary of Hohmann-type model is obtained according to the Hohmann transfer and Hohmann with coasts. Simulations are demonstrated to analyze the influences of the solution and distribution.

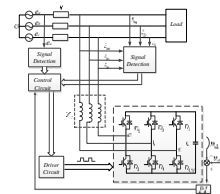


The distribution of Hohmann-type

## OS19-4 Research on SVG Control Method Under Unbalanced Conditions

Zheng Zheng, Yousong Zhou (Henan Polytechnic University, China)

SVG (static var generator) is an important equipment to improve the power quality. Aiming at the complexity of the alternating current positive and negative sequence component separation method under unbalanced operating conditions, the method based on complex filter is used to reduce the control computation. Because the traditional PI control can not eliminate the steady-state error of the grid current in the nonlinear disturbance, the control method of the proportional complex integral is adopted, and the traditional proportional complex integral control based on the  $\alpha \beta$  coordinate system according to the equivalent transformation relation of the phasor. The conversion to the three-phase coordinate system is based on the reduction of the amount of computation required for the traditional control to be improved by the Clark transform and the Clark inverse transform, and then gives a complete set of controller parameter tuning methods. Finally, a set of experimental platform based on DSP28335 is built. The experiment and simulation results verify the fastness and accuracy of the proposed positive and negative sequence component calculation methods and the stability and feasibility of the proportional complex integral control method.

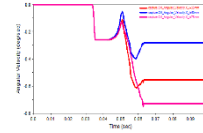


Main circuit topology of SVG

## OS19-5 Dynamics Analysis of Payload On-orbit Catapult Separation Based on ADAMS

Yi Li, Yingmin Jia (Beihang University (BUAA), China)

In this paper, a catapult separation device equipped with guide mechanism is designed firstly, and the corresponding dynamic model is built through multi-body dynamics theory. Then, based on the dynamic simulation software ADAMS, the virtual prototype model of the separation device is established and the whole process of payload on-orbit catapult separation is simulated. Finally, the structure design parameters of the guide mechanism such as the number of roller group, distance between rollers or the guiding length are studied and the influences of the parameters on the separation process are analyzed. The simulation results can be applied in the design and optimization of the separation device.



Angular velocity of payload under different distances

## OS20 Advances in Marine Robotics and It's Applications (5)

### OS20-1 A land testbed for experimental research on autonomous ship navigation

Keisuke Watanabe, Kazumasa Harada, Koshi Utsunomiya (Tokai University, Japan)

In the development of automated ship technology, experimental system is essential. The main navigation system is supposed to consist of GPS, AIS (Automatic Identification System), RADAR and cameras. In our land testbed, 2 ultrasound distance sensors are used as a model of GPS, which determine the coordinate of the testbed measuring the distances from 2 walls. A swinging ultrasound ranging sensor with a servo motor is used to simulate the RADAR. A xbee wireless communication module simulates the AIS. The camera is used for image processing to determine the control algorithm to avoid the collision from other moving obstacles. In this paper, we introduce our testbed's system assembly and an experiment to confirm functions of our concepts for our future experimental research on autonomous ship navigation.



### OS20-2 Seafloor Image Color Enhancement Method based on Retinex model and Experiment Report in the undersea environment

Jonghyun Ahn<sup>1</sup>, Shinsuke Yasukawa<sup>2</sup>, Yuya Nishida<sup>1</sup>, Takashi Sonoda<sup>1</sup>, Keisuke Watanabe<sup>3</sup>  
Kazuo Ishii<sup>1</sup> (<sup>1</sup>Kyushu Institute of Technology, <sup>2</sup>University of Tokyo, <sup>3</sup>Tokai University, Japan)

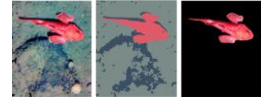
Underwater robot is one of the important research tools to explore deep-sea where high pressure, darkness, radio attenuation prevent humans from direct access. Especially, Autonomous Underwater Vehicles (AUVs) attract attentions because they don't have tethered cables and can move freely. One of the important tasks of AUV is to take the seafloor images, however, the sea-floor images should be enhanced as red color attenuates rapidly and images become bluish, and the small differences of AUV altitude to the sea-floor affect the brightness of images because of light attenuation. In this paper, automatic camera parameters adjustment method is proposed to enhance seafloor images and evaluated through experiments in the Suruga-bay.



### OS20-3 Automatic recognition of benthic species using image processing

Yuki Soejima, Yuya Nishida, Takashi Sonoda, Kazuo Ishii  
(Kyushu Institute of Technology, Japan)

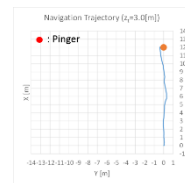
For sustainable use of fisheries resources, it is important to estimate the amount of resources such as TAC (Total Allowable Catch), TAE (Total Allowable Effort) and their investigations have been conducted by bottomed net fishing, however, the method suffers environmental damages. The survey method for wider area that does not affect the ecosystem is needed. Recently, research using an autonomous underwater robot (AUV) is introduced as a new survey method as the solution. We also introduced an AUV for the survey of fish and crabs in the Sea of Okhotsk. The number of marine lives is measured manually, and the technique of automatic measurement of the number is needed for the observation. In this research, we propose an automatic marine life recognition method from seafloor images.



### OS20-4 AUV homing using acoustic chirp signal

Koji Masuda, Yuya Nishida, Takashi Sonoda, Kazuo Ishii  
(Kyushu Institute of Technology, Japan)

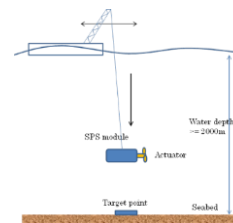
For autonomous underwater vehicle (AUV), high autonomy is required in order to accomplish mission such as inspection, observation, manipulation under extreme environments, deep-ocean. One of necessary function for AUV is acoustic navigation. In this paper, we conducted homing experiments using a small AUV and acoustic pinger with chirp signal. The chirp signal has the feature that the frequency of signal change gradually, so that the signal is suitable to calculate the correlation between the time difference between hydrophones. The homing experiments are carried out and evaluated through tank tests.



### OS20-5 Simulation of horizontal vibration suppression of a suspended structure for seabed mining

Keisuke Watanabe<sup>1</sup>, Kazuo Ishii (<sup>1</sup>Tokai University, Kyushu Institute of Technology, Japan)

In a project of subsea mining in the near future, many work class robots such as crawlers, drilling machines, or ore collectors will be installed on the seabed. These robots are heavy but they must be landed on the seabed very softly to avoid impact damage from the seabed. So the installation method is very important and effective installation method should be investigated. In this paper, we examined vibration motion of a suspended heavy machine by a crane vessel through dynamics modeling and simulation in the horizontal plane. Descending speed of the machine affects the amplitude of the vibration, that is, if the descending speed is higher, larger amplitude will be observed. To suppress this vibration, we examined a velocity feedback control by attaching a thruster to the machine. From simulation results, we found horizontal vibration will be effectively suppressed by using simple feedback control.

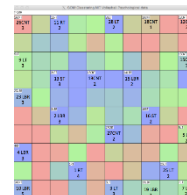


## OS21 Robot Competitions for Social Contribution (5)

### OS21-1 Analysis of Team Relationship using Self-Organizing Map for University Volleyball Players

Yasunori Takemura, Kazuya Oda, Michiyoshi Ono (Nishinippon Institute of Technology, Japan)

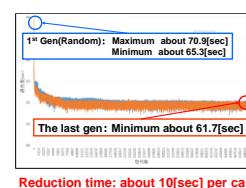
In Japan, sports efforts are actively being carried out to host the 2020 Olympic games. Especially in the field of sports science, researches on ergonomics, development of sports equipment and pattern recognition technology using artificial intelligence are actively researched. In previous research, we developed a clustering algorithm for positioning adaptation and relationships in team sports using Self-Organizing Maps in university rugby players. However, I have not yet confirmed whether the developed algorithm can be applied to other team sports. For this reason, we applied the same algorithm to an university volleyball player. Then, as an algorithm, we verify whether it can be generally used for team sports



### OS21-2 Optimization for Line of Cars Manufacturing Plant using Constrained Genetic Algorithm

Keiji Kamei, Takafumi Arai (NishiNippon Institute of Technology, Japan)

Recently, improvement of production efficiency on cars manufacturers is required owing to increasing of demands in developing countries. However, that improvements under existing circumstances are depending on experience and intuition by workers. For this, we propose to objectively and efficiently improve a production line based on a GA. The production line of candidate for optimization is “Picking up assemblies” area, so that our proposal optimizes the positions of racks and boxes for assemblies by a GA. The difficulty of applying a GA is that the number of racks and boxes is defined in advance. For this, we apply constrained GA to optimization for those positions. The results of simulation for virtual production line show that our proposal succeeded in reducing about 10 seconds per car compared with random positioning.



### OS21-3 Slip model of roller driven ball

Kenji Kimura<sup>1</sup>, Shota Chikushi, Kazuo Ishii  
(<sup>1</sup>Nippon-Bunri University, Kyushu Institute of Technology, Japan)

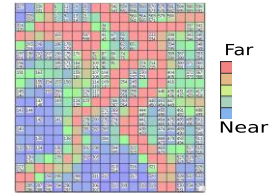
Spherical wheel motion driven by rollers attract attention due to the possibility of uneven surface. RoboCup is a platform designed to promote the research fields such as Artificial Intelligent (AI) and robotics, and one of examples is the ball dribbling mechanism of RoboCup Middle size league robot, and this mechanism controls the ball with two driving rollers. As the result of the survey at the 2017 World Cup, all teams in the world have determined the roller arrangement heuristicacclly, and no mathematical consideration has been made. In this study, we propose a model considering slip, discuss the relationship between slip ratio and robot speed using evaluation function, and verify the model by experiment.



## OS21-4 Strategy Analysis of Multi-Agent Games Using Self-Organizing Map

Moeko Tominaga, Yasunori Takemura<sup>1</sup>, Kazuo Ishii  
(Kyushu Institute of Technology, <sup>1</sup>NishiNippon Institute of Technology, Japan)

It is one of important subjects to know how humans and robots share the same space to realize a symbiotic society, for examples, strategies such as their positions and defense methods in multi-agent game, soccer. In the soccer games, the player's behavior changes depending on the game situation such as winning or losing, score gap, remaining time. The players act more offensive when their team is losing, or more defensive when their team is winning with minimum score difference. In this paper, we observe and analyze human soccer game, and estimate how the state vector of the player affects team behavior. The team strategy is analyzed based on parameters such as the positions of robots, the number of robots in play, scores, time and actions of robots using Self-Organizing Map (SOM).



## OS21-5 Analysis of Characteristics of Tomato Fruits in Infrared Images Toward Automatic Tomato Harvesting System

Takuya Fujinaga, Shinsuke Yasukawa, Binghe Li, Kazuo Ishii  
(Kyushu Institute of Technology, Japan)

Labor shortages and aging are big problems in Japanese agriculture field and farmers need systems for automation, efficiency and optimization. We focus on tomato fruits harvesting, which is one of the major fruit vegetables. Tomato harvesting needs longer working time than other fruits harvesting. We aim at the realize of a tomato automatic harvesting system, and have been researching and developing tomato harvesting robots that can harvest fruits and monitor the growth situation of tomato. It is necessary to detect the position and maturity of tomato fruit. In this paper, we analyze the plant characteristics of tomato using infrared images and propose tomato fruit recognition system. Images acquired at the tomato greenhouse of large scale facility were used. The analysis results of tomato fruits features in infrared images are reported.

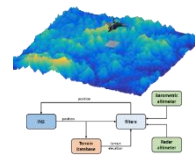


## OS22 Navigation and Control (3)

### OS22-1 Comparative Study of Sequential Processing TRN (Terrain Referenced Navigation)

Hyun Cheol Jeon and Chan Gook Park (Seoul National University, Korea)

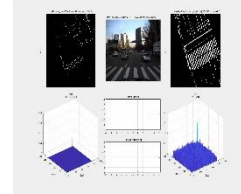
This study performs comparative analysis on the performance of sequential processing terrain referenced navigation (TRN) by applying various filtering techniques. The TRN is a navigation system that prevents divergence of inertial navigation system using terrain information. In this paper, we consider extended Kalman filter (EKF) and point mass filter (PMF) which are widely used in the TRN. The EKF estimates state variables by linearizing a nonlinear models but it has risk of divergence due to linearization errors. On the other hands, the PMF estimates the state variables robustly but it has a disadvantage of high computational load. Through this study, the advantages and disadvantages of the TRN when applying the EKF and PMF are compared and analyzed.



## OS22-2 Road Marking Map Matching for Road Vehicle Localization

Kyuwon Kim and Gyu-In Jee (Konkuk University, Korea)

In this paper, we propose map matching algorithm using road marking intensity map made of 3D LIDAR. The road marking is very useful in terms of availability because it is existed anywhere on the vehicle. The map matching algorithm is used phase correlation using FFT to enable very fast matching. In addition, the road marking map is generated by binarizing the intensity. As a result, a large-scale global map can be stored with a small capacity. In addition, LIDAR scan data was accumulated for generating a high precise density local map. Accumulated local map can be supported sufficient information, especially longitudinal information. Therefore, it can be more robust and precise vehicle localization.



## OS22-3 Control System Design of Directionally Maneuvering Multicopter with Independent Heading Rate

Byoungjin Lee, Jaehue Bae, Gwang Soo Park and Sangkyung Sung (Konkuk University, Korea)

In this paper, we present a comprehensive control system design of directionally maneuvering multicopter platform with independent heading rate. A directionally maneuvering multicopter system is capable of generating an arbitrary vehicle flight trajectory while it maintains an independent rotation with constant heading rate. For this, a quaternion based attitude controller is adopted in the control algorithm construction. Torque difference between clockwise and counterclockwise rotors is basically derived for yaw moment generation, while their thrust difference is harmonically configured for the desired waypoint flight via guidance logic.



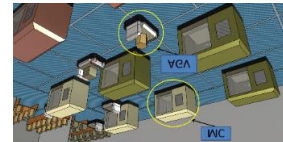
## GS abstracts

### GS1 RoboticsI (3)

#### GS1-1 Production simulation of autonomous decentralized FMS including AGVs with different personalities of mind

Ryuichi Tsujii, Hidehiko Yamamoto and Takayoshi Yamada (Gifu University, Japan)

This study researches Automated Guided Vehicles (AGVs) moving control by using the model of a mind in order to avoid AGVs' interferences in autonomous decentralized Flexible Manufacturing Systems (FMS). The model of a mind can avoid the interference by repeating the two types of mind changes, the arrogant mind and the modest mind. Further, we give some personalities to the mind. The personalities have different time to change from the arrogant mind and the modest mind. By carrying out the production simulations using the AGV group with the different personalities, we acquire the production outputs. As a result, the outputs are improved compared with the traditional AGV group with a single personality. It is ascertained that the models of minds expressing different personalities are useful.



#### GS1-2 Development of Automatic Recognition of Hazmat Marking Chart for Rescue Robot

Wisanu Jitviriyaya<sup>1</sup>, Poommitol Chaicherdkiat, Noppadol Pudchuen  
(King Mongkut's University of Technology North Bangkok, Thailand)  
Eiji Hayashi (Kyushu Institute of Technology, Japan)

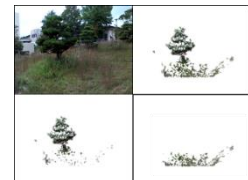
A long history in the 1<sup>st</sup> place awards of World RoboCup Rescue Robot competitions are Invigorating Robot Activity Project (iRAP) such as iRAP\_PRO, iRAP\_FURIOUS, iRAP\_JUNIOR and iRAP\_ROBOT teams. In this paper, we would like to introduce and explain an autonomous system of our rescue robot for detection and recognition of Hazardous Material (Hazmat) marking chart. All Hazmat tags are considered and computed by using Speeded-Up Robust Feature (SURF) combined with Fast Library for Approximate Nearest Neighbors (FLANN) in order to match with the templates. Finally, the paper presents experimental results based on real situations in order to confirm an effectiveness of the pattern recognition of robotics system.



#### GS1-3 Development of Autonomous Robot for Laborsaving of the Forestry - Discrimination between trees and weeds using RGB-D -

Shingo Yamaguchi, Eiji Hayashi, Ayumu Tominaga (Kyushu Institute of Technology, Japan)

In traditional forestry, the weeding task places a large burden on workers. Therefore, it has been expected that such the problem will be solved by a robot. We have been developing an autonomous robot that eliminates the weed plants without damaging trees (these are resources). The robot should recognize trees exists in the environment. In this research, we have been focused on distinguishing between trees and other them. The system computes the RGB histogram of pixels corresponding point-cloud data of the ground extracted by plane detection. The threshold values are determined to discriminate between trees and weeds by this histogram automatically. We show the effectiveness of the developed system.





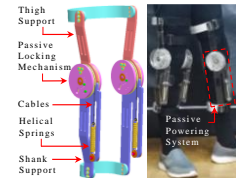
## GS2 Bipedal robot & Human-welfare robotics (6)

### GS2-1 Design and Evaluation of Passively Powered Knee Exoskeleton (PPKE) for Squat Lifting

R.K.P.S. Ranaweera<sup>1</sup>, R.A.R.C. Gopura<sup>1</sup>, T.S.S. Jayawardena<sup>1</sup>, G.K.I. Mann<sup>2</sup>

(<sup>1</sup>University of Moratuwa, Sri Lanka), (<sup>2</sup>Memorial University of Newfoundland, Canada)

This paper proposes a passively-powered knee exoskeleton (PPKE) to provide power assistance during squat lifting of objects from the ground. The passive powering mechanism is designed to capture 20% of the waste mechanical energy available at the biological knee joint during decent phase and to release the stored energy in ascending phase in a complete squatting cycle. The novel passive locking mechanism enables the wearer to ambulate freely posing minimum restrictions in-between squat lifting tasks. The anthropomorphic exoskeleton structure was fabricated using acrylic glass and powering system include elastic helical springs, where the entire working model only weighs at 900 g per unit. The effectiveness of proposed system was verified by experiments using surface electromyography (sEMG) signals under different test conditions. The exoskeleton is capable of reducing peak RMS averages of sEMG signals of knee extensor muscles by 15%. As such, preliminary results proved PPKE's potential to reduce human effort.



### GS2-2 Behavior design of robot arm imitating the consciousness mechanism of living organisms Representation of facial expression in transition process of emotion

Ryohei Anshi, Eiji Hayashi (Kyushu Institute of Technology, Japan)

Wisanu Jitviriya (King Mongkut's University of Technology, Thailand)

Sakmongkon Chumkamon (Rajamangala University of Technology, Thailand)

Although various service robots are being developed, social robots are required to have "user affinity", which gives the user a sense of affinity, in particular. In this research, we aim to realize user affinity by paying attention to living organisms that embrace healing and affinity, giving the robot consciousness, behavior, and emotion of living organisms. In the transmission of emotions, the eyes are important parts that express various psychological states due to changes in pupil size, eyelid opening / closing degree, shape, and the like. Therefore, we give two degrees of freedom to the eyeball and the eyelid, we can also change the pupil diameter and blink cycle, and constructed the system so that the expression also changes finely according to the change of the ratio of the eight emotions using the expression.

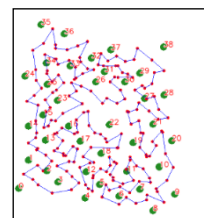


### GS2-3 Study of Robot Navigation for Forest Management

Ayumu Tominaga, Eiji Hayashi (Kyushu Institute of Technology, Japan)

Abbe Mowshowits (The City College of New York, USA)

We have been developing a robotic system for labor-saving of forestry that moves between trees and cut weeds plants without damaging the trees. The trajectory computation of the forest is carried out based on a weighted graph with trees as vertices. The line graph  $L(G)$  calculated from first graph represents a graph connecting the midpoints of each tree pairs that the robot can safely pass through, and the Hamiltonian circuit calculated therefrom is give a path plan for the robot to pass through all the tree pairs and return to its starting position. In order to follow the trajectory path, we combined the obstacle avoidance behavior and the vision system which has actuator for pan angle rotate.



## GS2-4 Development of the sense system that is combined force feedback and visual feedback -Deformable virtual objects simulation by using LEM-

Kaito Nagano, Eiji Hayashi (Kyushu Institute of Technology, Japan)

In the medical treatment and bio-technology field, doctors and researchers need technologies that can accurately perform minute work. Such minute work is improved by using micromanipulators, but their operation is difficult because the operator has no sense of force. As a result, a person who has the skill to do minute work is needed for all minute works. The purpose of this research is to develop a combined sense system that uses both force feedback and visual feedback on a deformable virtual objects simulation. Especially, focus on a way to produce a force that is calculated in simulation of deformation using a haptic device. As the first stage, our simulation of deformation was improved by using LEM (Long Element Method) and evaluated accuracy of a virtual object's deformation.



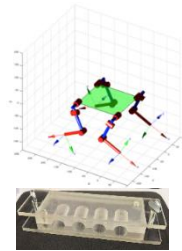
## GS2-5 A four-legged robot's soft feet structural design and walking gait generated from inverse kinematics

Amornphun Phunopas<sup>1</sup>, Eiji Hayashi<sup>2</sup>

(<sup>1</sup>King Mongkut's University of Technology North Bangkok, Thailand,

<sup>2</sup>Kyushu Institute of Technology, Japan)

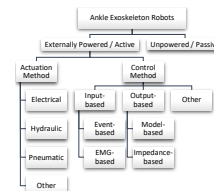
The conventional wheel is famous in the industrial mobile robot because it is simple to build and easy to control and to maneuver. On the other hand, the legged robot is complicated to control but has a high performance in locomotion like highly evolved legged-creatures. This research describes the four-legged robot design platform with the soft feet, which are made by silicone-material forming. The robot's feet are implanted by the strain gauge sensor. The robot can percept the external force sensitively when its feet touch something. The research demonstrates the forward kinematics and inverse kinematics of a four-legged robot with three joints for each. The result has validated the kinematic equations by implementing them on the real dog-like pet robot. The robot walked with a pure walking gait and showed a sensing signal from the soft foot and ground contact.



## GS2-6 Powered Ankle Exoskeletons: Existent Designs and Control Systems

A.H. Weerasingha, W.P.K. Withanage, A.D.K.H. Pragnathilaka, R.K.P.S. Ranaweera, R.A.R.C. Gopura(University of Moratuwa, Sri Lanka)

Powered ankle exoskeleton is a wearable device fitted to the ankle joint for purposes such as rehabilitation, power augmentation and locomotion assistance. Although variety of technologies were developed, commercial application was found to be minimal owing to various limitations with respect to both function and performance. Notably, conservation of metabolic energy, anatomical conformance, agility during operation, etc. are lacking factors in contemporary exoskeletons robots. In order to realize rational solutions, an improved understanding of the existent designs and control systems is paramount. In that context, this paper performs a comprehensive review on active ankle exoskeletons powered by external means. Initially, anatomy of the ankle joint complex is highlighted. Next, associated research challenges and design difficulties are recognized for the development of robotic hardware systems. Then, mechanisms, actuation methods, and control methods are systematically presented. Here, exoskeletons designs from 2005 to 2017 were studied to recognize the latest paradigm shifts. As such, this paper provides a classification, a comparison and an overview of related technologies. Finally, design recommendations are made on observed trends and patterns for the development of powered ankle exoskeletons.



## GS3 Complexity (5)

### GS3-1 Management of digital records inspired by Complex Systems with RADAR

Anne Jeannin-Girardon, Alexandre Bruyant, Nicolas Toussaint, Pierre Collet, Pierre Parrend (University of Strasbourg, ECAM Strasbourg-Europe, France)

(Big)Data storage poses two major challenges: security (data can be very sensitive, e.g. medical or financial records) and robustness (IT infrastructure may not be reliable due to faulty hardware, bad internet access or even power outage, especially in developing countries). Centralization in data-centres can therefore lead to bottlenecks and significant losses, in case of failure or intermittent connexions. Sensitive data must also be reliably backed-up. However, manual or automatic backups are prone to errors or failures. Consequently, we propose to apply the principles of Complex Systems (sets of autonomous interacting entities exhibiting emergent behaviour) to the problematics of storing and backing-up sensitive data in a platform called RADAR (Robust Anonymous DATA Records). Storage is no longer centralized: RADAR instances automatically fragment, replicate and distribute the data randomly over a cooperative network for anonymized and encrypted robust and secure backups and storage even over non-reliable IT infrastructure.



### GS3-2 Integrated optimization of differential evolution with grasshopper optimization algorithm

Duangjai Jitkongchuen, Udomlux Ampant (Dhurakij Pundit University, Thailand)

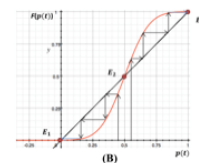
This paper proposes a scheme to improve the differential evolution algorithm (DE) performance with integrated the grasshopper optimization algorithm (GOA). The grasshopper optimization algorithm which mimics the behavior of grasshopper. The characteristic of grasshoppers is slow movement in the larval stage but sudden movement in the adulthood which seem as exploration and exploitation. The grasshopper optimization algorithm concept is added to DE to guide the search process for potential solutions. The efficiency of the DE/GOA is validated by testing on unimodal and multimodal benchmarks optimization problems. The results prove that the DE/GOA algorithm is competitive compared to the other meta-heuristic algorithms.



### GS3-3 Efficient collective search by agents that remember failures

Masao Kubo, Nhuhai Phung, Hiroshi Sato (National Defense Academy of Japan, Japan)

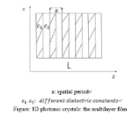
The BRT is an algorithm that the agents can find appropriate collective actions by changing their agreement in a trial-and-error manner. When the solution is the only one, computer simulations shows the number of times to find the solution is proportional to the square of the number of their collective choices on average. In this paper we propose an agent that remember failures behaviors to improve the searching time. Since the agent does not propose wrong behavior, it is trivial that the whole search time will be shortened. In this research, we exchanged the BRT agent and this "never suggest again" agent and investigated the search time and its ratio. As a result, we found that even a small number of the proposed agents can improve search time.



### GS3-4 The analysis of band structures of photonic crystals

Wang Chenxu (Muroran Institute of Technology, Japan),  
Fu Ziyi (Henan Polytechnic University, China)

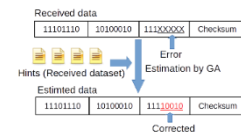
In this paper, a finite element is developed to calculate the band structures of one-dimensional photonic crystals. The Maxwell equation governing the propagation of electromagnetic waves, which combine with Bloch theory, the FEM transforms the complex band diagram problems into a simple eigenvalue problem by solving the eigenvalue with respect to wave vector  $K$  by frequency



### GS3-5 A Data Estimation Technique for Incomplete Telemetry Data Based on a Genetic Algorithm with Data's Statistical Properties

Masahiro Tokumitsu, Kaito Mikami (National Institute of Technology, Yonago College, Japan)  
Fumio Asai (The Radio Amateur Satellite Corporation, USA)  
Taku Takada (National Institute of Technology, Kochi College, Japan)  
Makoto Wakabayashi (National Institute of Technology, Niihama College, Japan)

Satellites transmit telemetry data to ground stations in order to provide the data on their missions. The telemetry data contain a sort of data such as observations, experiments, and satellites' health status. However, the telemetry data received by the ground stations may contain errors by effects through the transmissions. This paper proposes a data estimation technique for incomplete telemetry data to attain a high availability of the received telemetry data. The proposed technique is based on a genetic algorithm with data's statistical properties. This paper demonstrates the proposed technique with simple examples. In simulations, this paper examines the proposed technique for applying the actual telemetry data obtained by the particular satellite.



### GS4 Pattern recognition & Image processing (5)

#### GS4-1 Study on Detection of Nests on Pylon from Overhead View Based on Halcon

Jiwu Wang, Haibao Luo, Pengfei Yu (Beijing Jiaotong University, China)

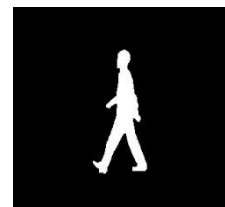
There are many difficulties when researchers want to detect the nests on pylons in the electricity transmission network with image processing methods. One major difficulty is to position the pylon precisely in the image because of the variance of shooting angle and shooting distance. Plus the unobvious features of nest's edge, color and shape in the background of the image make the single-feature-based detection methods fail to realize precise positioning. Thus, this paper addresses an effective method based on Halcon, which could detect the nest in the images from unmanned aerial vehicles (UAVs). This method eliminates most of the background interference by recognizing the pylon area in the image using the Blob algorithm. Within this area, the fusion of texture and gray-scale features of nest are employed to realize the detection. An experiment result is presented to validate that this method can actually realize the precise detection of nests on pylons with images shot by the UAVs.



## GS4-2 Human gait recognition based on Caffe deep learning framework

Jiwu Wang, Feng Chen (Beijing Jiaotong University, China)

Human gait recognition as an emerging biometrics technology has important theoretical significance and practical value. At present, the research on human gait recognition is still in the stage of theoretical exploration, and most of the methods to recognize the targets are realized by the traditional pattern recognition methods, which have no many advantages in detection accuracy and speed of detection. With the development of deep learning theory and technology, this paper will achieve human gait recognition of specific targets based on Caffe deep learning framework through the faster-rcnn algorithm. The main contents of the paper include the samples processing, model training and result testing.



## GS4-3 Unsupervised Image Classification Using Multi-Autoencoder and K-means++

Shingo Mabuchi, Kyoichiro Kobayashi, Masanao Obayashi, Takashi Kuremoto (Yamaguchi University, Japan)

Image classification using machine learning has been actively studied. However, machine learning, especially deep learning, needs a large number of training data. It is tough and impractical task for users to give correct class labels to the data. Therefore, an unsupervised image classification system is proposed in this paper. The proposed method consists of multi-autoencoder and K-means++. Since it is difficult to realize unsupervised classification system due to the lack of class information, the proposed method applies some image processing techniques to the images, and the feature values are extracted from the original images and the processed images using multi-autoencoder. The images with the extracted features are clustered by K-means++ algorithm, which can make groups of similar images.

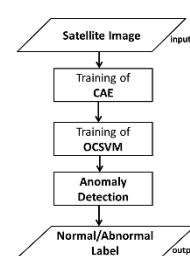


Ground piano cluster

## GS4-4 Anomaly Detection of Disaster Areas from Satellite Images Using Convolutional Autoencoder and One-class SVM

Kohki Fujita, Shingo Mabuchi, Takashi Kuremoto (Yamaguchi University, Japan)

In recent years, research on detecting disaster areas from satellite images have been conducted. When machine learning is used for disaster area detection, a large number of training data is required, however, we cannot obtain so much training data with correct class labels. Therefore, in this research, we propose an anomaly detection system that finds abnormal areas that deviate from normal ones. The proposed method uses a convolutional autoencoder (CAE) and One-class SVM (OCSVM). First, CAE executes feature extraction from satellite images. Second, OCSVM is trained using images of normal areas only. Finally, anomaly detection for the testing images is carried out by the trained OCSVM. In the performance evaluation, the proposed method shows better performance than the method with OCSVM only.

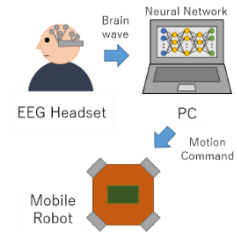


### GS5 Neuroscience (3)

#### GS5-1 Improving EEG-based BCI Neural Networks for Mobile Robot Control by Bayesian Optimization

Takuya Hayakawa, Jun Kobayashi (Kyushu Institute of Technology, Japan)

The aim of this study is to improve classification performance of neural networks as an EEG-based BCI for mobile robot control by means of Bayesian Optimization of learning parameters and hyperparameters in training the neural networks. The parameters were intuitively decided in our preceding study. However, the performance will be improved if the parameters are determined in an appropriate way. There are several methods for parameter optimization. Grid Search draws a grid on a parameter search space, examining all intersection representing a combination of the parameters. The method can find the best parameters with a high probability, but it takes a huge amount of time. The authors have used Bayesian Optimization to optimize the parameters in a shorter time and achieved the better performance.



#### GS5-2 Selective synchronization of the coupled bifurcating neurons for phase shift of background oscillation

Akihiro Yamaguchi<sup>1</sup>, Yutaka Yamaguti<sup>1</sup>, Masao Kubo<sup>2</sup> (<sup>1</sup>Fukuoka Institute of Technology, <sup>2</sup>National Defense Academy of Japan, Japan)

Synchronization in the coupled bifurcating neurons was studied in the view point of the selective formation of cell assembly. The bifurcating neuron is a simple chaotic neuron that exhibits chaotic inter-spike interval dynamic by adding the sinusoidal background oscillation. In this research, we introduce the phase shift of the background oscillation and the several types of phase response to the input spike sequence. The coupled 16 bifurcating neurons with complete bidirectional coupling were numerically simulated and their synchronized behaviors were observed, where each 4 neurons have the same phase shift value that is different with the other neurons. Fig. 1 shows the synchronization ratio of each pair of neurons. This result indicates the formation of chaotically synchronized cell assembly for the same phase shift value.

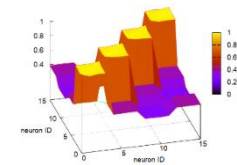


Fig. 1 Synchronization ratio of neurons

#### GS5-3 Review on computational techniques in solving aircraft landing problem

Aminurafiuiddin Zulkifli, Nor Azlina Ab. Aziz, Nor Hidayati Abdul Aziz

(Multimedia University, Malaysia)

Zuwairie Ibrahim (Universiti Malaysia, Malaysia)

Norrma Mokhtar (University of Malaya, Malaysia)

The problem of sequencing and scheduling arriving aircraft landing is commonly known as aircraft landing problem (ALP). This problem, due to various constraints such as the number of arriving aircrafts, the number of runways, the mode of runway operation, the type of arriving aircrafts, the minimum separation between each arriving aircraft, and the weather condition, is considered to be a NP-hard problem. Therefore, it is almost impossible to compute every possible solution and computational intelligence methods had been adopted to solve ALP. In this paper, we review the computational intelligence techniques used in ALP. The main techniques include the evolutionary algorithms namely; genetic algorithm, genetic programming, scatter search and bionomic algorithm, the swarm intelligence algorithms like particle swarm optimization and ant colony optimization and also other methods such as the constrained position shifting and dynamic programming.

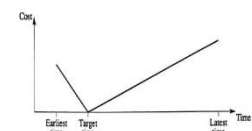


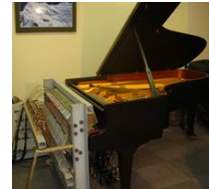
Figure 1. Cost variation in time window during flight

## **GS6 Virtual reality (5)**

### **GS6-1 Interactive musical editing system to support human errors and offer personal preferences for an automatic piano -Inferring performance expression by considering change of pitch-**

Masahiro Ushio, Eiji Hayashi (Kyushu Institute of Technology, Japan)

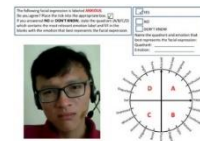
Electronic musical instruments' sound quality and ambience are inferior to real musical instruments. Therefore, we developed automatic piano by using grand piano. Pre-edit is needed to play music in the manner of a live pianist. In the case of piano music, there are often 1000 or more notes in the score of even a short piece of music, requiring that an editor spend a huge amount of time to accurately simulate the emotionally expressive performance of a highly skilled pianist. Therefore, we have developed an interactive musical editing system that utilizes a database to edit music more efficiently. This paper, we made a hypothesis that the pianist's performance is characterized by the pitch change, and we introduced the pianist features which considered the pitch change to further improve the efficiency.



### **GS6-2 Analysis of Malaysian Facial Expressions for Designing Virtual Agents**

Halimahtun Khalid (Damai Sciences, Malaysia), Liew Wei Shiung  
(University of Malaya, Malaysia)

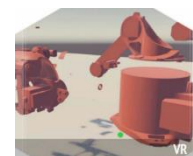
The perception of emotion based on facial expressions is culturally mediated. East Asians tend to focus on the central region around the nose and eyes, while Western Caucasians observe the eyebrows and mouth regions. Therefore, designing a virtual avatar with realistic facial expressions to convey emotions should consider the demographics of the users who would be interacting with the avatar. We conducted an online study to determine the facial measurements for specific emotions as perceived by Malaysians. Twenty-four facial expressions were shown to 37 subjects and they were instructed to select which emotion label matched each expression. The expressions were then decomposed into facial action unit measurements using OpenFace. Regression analysis was used to determine the combination of measurements corresponding to each emotion label. The facial expressions were then used to design the virtual agents in an experiment on human-avatar interaction where 48 subjects evaluated the virtual agents on trust.



### **GS6-3 Development of VR system to enhance understanding process of robot mechanisms**

Alexei Lushnikov, Vlada Kugurakova, Timur Satdarov, Artur Nizamutdinov  
(Kazan Federal University, Russia)

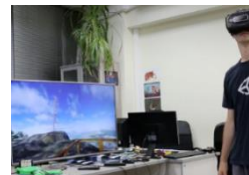
For engineers and technicians in training honing one's skills in working with machines are essential. Very unfortunately, access to facilities required for this is pretty much may not always be provided: such facilities might be in short supply, or the time one is allowed to use them might be restricted, or they might be simply not present in the vicinity. The solution to this problem that we propose is the use of VR simulation of tasks that would be normally carried out at the specialized facilities, such as assembling-disassembling, maintenance, and use. To provide the most realistic and immersive experience, the simulation would be fitted with haptic feedback. This study describes the ongoing project on design and implementation of such VR system.



## **GS6-4 Towards the immersive VR: measuring and assessing realism of user experience**

Vlada Kugurakova, Murad Khafizov, Alexander Elizarov, Alexei Lushnikov,  
Artur Nizamutdinov (Kazan Federal University, Russia)

The range of uses for Virtual Reality Continuum grows more diverse, with potential fields of application spanning from research and education to leisure and work, which increases demand for a method which can allow to precisely and reliably measure VR effectiveness. How can we determine the quality of VR? How do different people respond to its varying implementations? And could it be true that different social groups interact with VR differently? In this paper, we propose a new approach to this emerging problem, which involves applying user interface (UI) metrics to VR experience. We review existing ways to increase VR immersion and outline a series of possible experiments to study and, hopefully, find a correlation between immersiveness and VR user interface effectiveness.



## **GS6-5 Lessons on the Reality-Gap: Iterations between Virtual and Real Robots**

Andre Rosendo (ShanghaiTech University, China),  
Charlie Houseago, Fumiya Iida (Cambridge University, UK)

Due to abstractions and approximations between the virtual and real world, the transfer of knowledge from virtual (simulations) to real (robots) world is problematic. As physical conditions are prone to unknown and stochastic noise sources, the predictability reduces. In here we use data experiments from 100 real robots to tune the parameters of a simulation, and later used this tuned simulator to improve the design of the previous robots and find the optimum robot. We compare the simulated and real world behavior of this robot, and discuss our results. In this paper we address the Reality Gap by tuning a Bullet physics simulator with results extracted from real experiments with robots. Parameters defining the interaction between the robot and the floor (friction and restitution) are tuned to minimize the error between the simulated and actual behavior, and the simulated trajectories of 100 agents are compared to the trajectories of the real-world counterpart. With the newly found set of physical parameters, the simulation is then used to predict, through a Random Search approach, a robot capable of outperforming the previous ones. This new robot is built and we observe that although differences exist between the simulated and actual behavior, the final robot's trajectory strongly resembles the one predicted by the simulation. Next steps should consider stochastic differences between experiments to improve the predictability of the system.



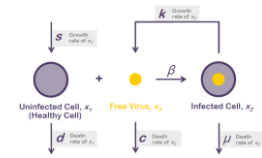


### GS7 Intelligent control (3)

## GS7-1 Fractional Order Sliding Mode Control Applying on the HIV Infection System

Thunyaseth Sethaput<sup>1</sup>, Arsit Boonyaprapasorn<sup>2</sup>  
(<sup>1</sup>Thammasat University, <sup>2</sup>Chulachomklao Royal Military Academy, Thailand)

The mathematical model of HIV dynamical system explains the interaction between immune system and virus. It represents the relationship among population size of uninfected CD4+ cells, infected CD4+ cell, and virus. The aim of the treatment is to drive the amount of uninfected CD4+ cells to the desired level and the amount of both infected CD4+ cells and virus particles approach to zero as time increased. The main objective of this study is to apply the fractional order sliding mode control (FOSMC) method to regulate HIV infection. The performance of the control method was investigated via simulation. According to the simulation of the controlled HIV system, the state variables approach to the desired values. Thus, it is feasible to apply the FOSMC method to define the treatment of the HIV infection system.



## GS7-2 Skill-based Job Rotation Scheduling for Occupational Noise Exposure Control

Pavinee Rerkjirattikarn, Chatdanai Kaorapapaong, Sun Olapiriyakul  
(Thammasat University, Thailand)

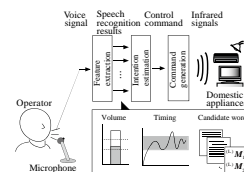
Job rotation is an inexpensive and flexible administrative control measure, used to prevent workers from being exposed to harmful levels of occupational hazards. Despite its advantages, job rotation can affect process continuity and workers' control over the timing of their work hours, resulting in reduced productivity and job satisfaction. This paper proposes a job rotation methodology for manufacturing systems with independent workstations. An integer-programming model is formulated, to determine workforce schedules capable of meeting customer demands and skill requirements for tasks, while simultaneously minimizing operational cost and reducing noise exposure levels of workers to a safe level. The overtime assignment is considered to ensure the fairness and appropriateness of the work schedules. The cost effectiveness of workforce schedules is evaluated under different overtime policies and production capacity levels. The results of this study will help decision makers to select the best workforce schedule, based on the desired production levels and overtime policies.



## GS7-3 A Training Method for the Speech Controlled Environmental Control System Based on Candidate Word Discriminations

Taro Shibanoki, Masaki Watanabe (Ibaraki University, Japan), Go Nakamura, Takaki Chin (Hyogo Rehabilitation Center, Japan), Toshio Tsuji (Hiroshima University)

This paper proposes a concept of a training system for the speech controlled environmental control system: Bio-Remote based on candidate word discriminations. The proposed system can provide three-types of voice signal training: (1) volume, (2) timing and (3) candidate word which are important for accurate speech recognition based on false recognition results. During the training, such three kinds of features are extracted from measured voice signals and visually and auditory fed back to the user in real time. This allows the user to train speech abilities even if false recognition results are extracted because of slurred speech. The efficacy of the proposed system is demonstrated through training experiments for slurred speech conducted with healthy participants. The results show that the proposed training system is capable for train the speech abilities.

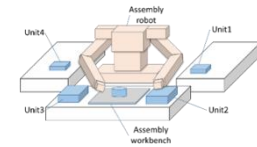


## GS8 RoboticsII (5)

### GS8-1 Design System of Cell Type Assembly Machine with Dual Arms Robot by GA

Keita Honda, Hidehiko Yamamoto and Takayoshi Yamada (Gifu University, Japan)

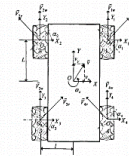
The purpose of this research is to develop a system named DELUGA which automatically decides to place a lot of assembled parts, jigs and robot hands of a cell type Assembly Machine by genetic algorithm (GA). The robot of our research adopts a dual arms robot. DELUGA consists of two modules, the conditions module and GA module. The conditions module reads work data for robot, and sets various parameters required for GA. GA module decides the efficient arrangement place of parts, for example jigs and robot hands, by GA, and outputs the acquired arrangement image. Because the left and right robot arms simultaneously carry out assembly works, DELUGA adopts the concept of waiting time of each robot arm to prevent arms interference. We applied DELUGA to assembly machine of an in-wheel motor for electric vehicles. The application resulted that the production efficiency increased. It is ascertained that DELUGA is useful.



### GS8-2 Spherical Mobile Robot Driven by Biorthogonal Omnidirectional Wheels

Liu Wei, Ma Shuanglong, Duan Lunqin, Yu Jiangtao (Beijing Jiaotong University, China)  
University, China)

This paper presents a new spherical mobile robot driven by omnidirectional wheels. The structure is that there are two independent driving omnidirectional wheels located at the ends of the inside vertical diameter of the sphere shell, and the two wheel axes are in orthogonal position. Its principle is, that the omnidirectional wheels can roll on the inner surface of the spherical shell by the friction force, then drive the spherical shell rolling. The lower end omnidirectional wheel is responsible for walking drive, and the upper end one for steering drive.



### GS8-3 Coordinated behaviour with a Pepper Humanoid robot to estimate the distance of other robot using Inverse Perspective Mapping

M. Hassan Tanveer, Antonio Sgorbissa, Carmine T. Recchiuto  
(University of Genova, Italy)

This article discusses a strategy for real time distance determination applied to a humanoid robot (Pepper, Softbank Robotics) that is requested to collaborate with other robots. However, using the monocular camera embedded on the robot head, it is difficult to determine distance to objects in front of the robot with any degree of certainty. The reason is non linear relationship between the height allocation of camera and its distance to an object in a camera frame. So, the proposed method is based on the extraction of accurate bird's-eye view images, by applying Surface Subtraction and Inverse Perspective Mapping (IPM) to the images captured with the Pepper head camera. The algorithm is implemented in the Python language using the OpenCV libraries

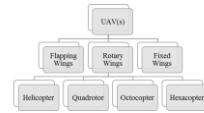


Fig. 1: Pepper FOV

## GS8-4 Control Techniques of Quadrotor Uavs: A Concise Study

<sup>1</sup>Syed Faiz Ahmed, <sup>1</sup>Athat Ali, <sup>1</sup>M. Kamran Joyo, <sup>1</sup>Khusairy Abd Kader, <sup>2</sup>Hazry Desa, <sup>3</sup>Sheroz Khan (<sup>1</sup>Universiti Kuala Lumpur, British Malaysian Institute, Malaysia, <sup>2</sup>Universiti Malaysia Perlis, Malaysia, <sup>3</sup>International Islamic University Malaysia, Malaysia)

Quadrotors, the four wing UAV has drawn prominent attention amongst the researchers. The simple nonlinear structure design requires a robust control to ensure the stability during the flight. The noisy and environment with unexpected disturbances may cause issues such as drift in position. In order to tackle the severe conditions a robust control is required. This paper provides an overview of the available quadrotor models and the control techniques with their application in quadrotor control issues.



## GS8-5 A GIS Based River Water Level & Flood Prediction System

Sarmad Zafar, H.M.SohaibAzhar  
(Mohammad Ali Jinnah University, Pakistan)

We are publishing the collected abstracts for the ICAROB participants. It will help the participants for guiding them to the interesting session. The abstract, including a text, an illustration, or a chart, must be kept within **10 rows** shown in this template. The abstract consists of the paper title, the author's name(s), the affiliation(s), text and the most impressive one illustration. Time New Roman is required for its font. Please use 12-point for the title, 11-point for your name(s), affiliation and country(s) and 10-point for the text. Do not write or print anything outside the print area. For your convenience, we provide this template to allow you to prepare the abstract with MS-WORD easily. (Times New Roman 10 Point)

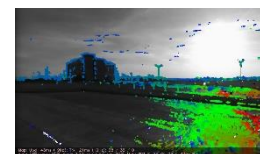


## GS9 Poster (11)

### GS9-1 Analysis of onboard sensor-based odometry for a quadrotor UAV in outdoor environment

Aidar Gabdullin, Grigory Shvedov, Mikhail Ivanou, Ilya Afanasyev  
(Innopolis University, Russia)  
Konstantin Yakovlev (Russian Academy of Science, Russia)

This article introduces a comparative analysis of a quadrotor UAV trajectories evaluated by onboard sensors (camera, IMU and GPS) and ROS-based monocular visual odometry. Parrot Bebop drone was launched outdoor in autonomous mode according to teleoperated closed-loop trajectory along an a-priori known perimeter of a square work area (measured by a tape measure as a ground truth) and recorded sensors telemetry data for offline processing. To verify UAV odometry trajectory, we used Bebop's firmware with integrated visual-inertial velocity estimation, the ground truth and an external observer.



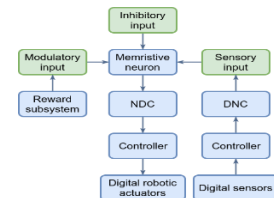
## GS9-2 Memristive neuron integration in digital robotic embodiment

Max Talanov, Evgenii Zykov, Yuriy Gerasimov, Evgeni Magid, Aleksander Elizarov  
(Kazan Federal University, Russia)

Victor Erokhin

(Italian National Council of Research, Parma, Italy)

In the current paper, we introduce a high-level approach for an integration of a neuromorphic memristive neuron in a real-time operating robotic system. The memristive neuron schematic, which we had presented in our earlier works, is capable of inhibitory and excitatory learning (eSTDP, iSTDP) as well as modulation via dopamine input. We discuss a possibility of integration of the analog memristive neuron into a digital robotic embodiment and present block diagram of an adapter that includes pseudo-neuronal encoder and decoder.



## GS9-3 Russian mobile robot Servosila Engineer: designing an optimal integration of an extra laser range finder for SLAM purposes

Neil Alishev, Yuriy Gerasimov, Roman Lavrenov (Kazan Federal University, Russia)

In our current research we determine an optimal design for integration of Hokuyo UTM-30LX-EW LRF into control system of Russian mobile robot Servosila Engineer. We designed and constructed a special static stand with an option to select an inclination of a scanning beam toward the surface of an environment. RBPF SLAM algorithm was tested to perform localization and mapping. Experiments were conducted in order to determine the best configuration of the LRF position and RBPF SLAM algorithm parameters.



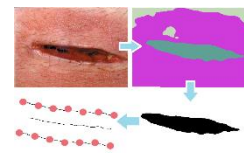
## GS9-4 Toward automated open wound suturing using haptic feedback: detecting wounds and planning the suture

Artur Sagitov<sup>1</sup>, Hongbing Li<sup>2</sup>, Evgeni Magid<sup>1</sup>

(<sup>1</sup>Kazan Federal University, Russia)

(<sup>2</sup>Shanghai Jiao Tong University, China)

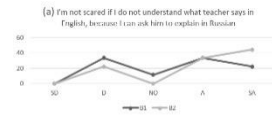
One of the key disadvantages of robotic surgery as of today is the lack of haptic feedback. While in traditional surgery surgeons using their haptic senses in all tasks most medical robot lack this ability. Using robots with haptic feedback have the potential of reducing the time spend by surgeon on such tedious subtasks as suturing helps reducing surgeon fatigue. Also decreasing the manual input of the surgeon enables remote surgery even using long communication links with big latency. In this paper we present a framework of wound detection and suture planning. We plan to implement and test our algorithms using KUKA iiwa manipulator.



## GS9-5 Establishing Effective Teaching for Robotics: a comparison study of Bachelor students in Introduction to Robotics course

Tatyana Tsoy, Leysan Sabirova, Mikhail Abramskiy, Evgeni Magid  
(Kazan Federal University, Russia)

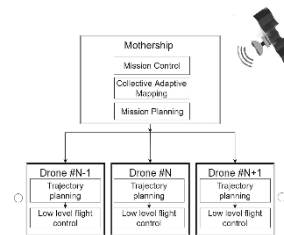
Global demand in robotics specialists arose necessity of establishing educational programs in robotics, which sets new challenges for modern educational system. In 2017 Kazan Federal University launched master's program in Intelligent Robotics to produce specialists considering core engineering competences and such important skills as self-motivation, critical thinking etc. This paper presents results of continuous survey among undergraduate students of Introduction to Robotics course that helps understanding dynamics of student's motivation to study robotics, attitude toward education methods to improve teaching strategies



## GS9-6 Development of a heterogeneous aerial swarm control framework for forest management

Yuriy Gerasimov, Artur Sagitov, Evgeni Magid (Kazan Federal University, Russia)

As the prevalence of UAVs is increasing, they are becoming more accessible for wider applications. Our interest is in application of UAVs for forest management challenges including health and safety monitoring and commercial exploitation in a sustainable manner. We propose a swarm control framework for managing a group of UAVs for aforementioned tasks, including survey of tree health with infrared cameras and chemical sensors, detecting potential risky situations of illegal logging, smoke and fires, and estimating potential volume measurements. The proposed framework manages planning flight trajectories, sensor fusion and collaborative mapping. On the next stage, we plan to simulate the framework in ROS/Gazebo environment, and further to implement a pilot project with a group of DJI Phantom quadrotors and a large-size fixed-wing UAV.



## GS9-7 Implementation of ROS package for simultaneous video streaming from several different cameras

Ramil Safin, Roman Lavrenov (Kazan Federal University, Russia)

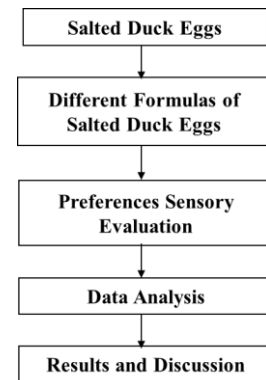
Real time video stream capturing and processing is important for a variety of tasks in robotics. We created ROS package that captures concurrent video stream from 4 different cameras of Russian mobile robot "Servosila" Engineer. V4L2 API was used to configure video devices and to retrieve raw data from cameras. Memory mapping approach of mapping device buffers increased overall performance by eliminating redundant memory copies. We demonstrate the comparison of our new package and OpenCV based package.



## GS9-8 Consumers Preferences and Purchase Intention on New Taste of Salted Duck Eggs

Shang-Hui Li (Far East University, Taiwan)

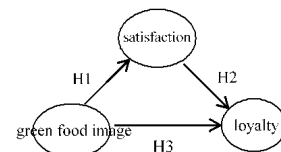
Egg is an indispensable food in people's daily life. Egg is rich in protein, easily digested by human body and metabolism. In addition to direct consumption, people created many different processed egg products by the characteristics of eggs. The traditional method of making salted duck eggs is to place the eggs in salt water or coated in laterite without any additional chemical composition. Except the eggs, this study joined other natural ingredients To produce eight different flavors of salted duck eggs. In the formal test, 70 convenience sampling were taken from Tainan area for sensory evaluation, 63 valid questionnaires, SPSS18.0 was used as the statistical analysis. Sensory evaluation included the color, oil, smell, salty and taste of egg yolk and the salty, taste of protein. Moreover, with the overall acceptance, purchase intention and willingness to buy again etc. The study results showed that cinnamon red salted duck eggs and four-herb salted duck eggs are the highest acceptance to consumers, followed by the salted citronella duck eggs. However, four-herb salted duck eggs dipped by the salted water are not favored by consumers.



## GS9-9 The Study of Green Food Image, Satisfaction and Loyalty through the Perspective of Elaboration Likelihood Model

Shu-Fang Hsu (Far East University, Taiwan)

This study aims to explore the relevance of consumer satisfaction and loyalty to green food image through the perspective of Elaboration Likelihood Model. The results show that the positive impact of green food image; and will indirectly affect the satisfaction of re-purchase intention; satisfaction positive impact loyalty. We hope that the results of this study can provide relevant business management strategies and suggestions, the green food consumption theory and practice can be dedicated.



## **GS9-10 Self-Generated Dataset for Category and Pose Estimation of Deformable Object for Manipulation by Robot**

Yew Cheong Hou, Khairul Salleh Mohamed Sahari (Universiti Tenaga Nasional, Malaysia)

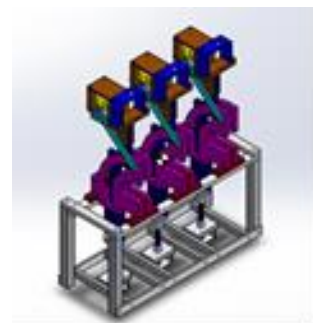
This work considers the problem of garment handling by a general household robot that focuses on the task of classification and pose estimation of a hanging garment in unfolding procedure. Classification and pose estimation of deformable objects such as garment are considered a challenging problem in autonomous robotic manipulation because these objects are in different sizes and can be deformed into different poses when manipulating them. Hence, we propose a self-generated synthetic dataset for classifying the category and estimating the pose of garment using a single manipulator. We present an approach to this problem by first constructing a garment mesh model into a piece of garment that crudely spread-out on the flat platform using particle based modeling and then the parameters such as landmarks and robotic grasping points can be estimated from the garment mesh model. Later, the spread-out garment is picked up by a single robotic manipulator and the 2D garment mesh model is simulated in 3D virtual environment. A dataset of hanging garment can be generated by capturing the depth images of real garment at the robotic platform and also the images of garment mesh model from offline simulation respectively. The synthetic dataset collected from simulation shown the approach performed well and applicable on a different of similar garment. Thus, the category and pose recognition of the garment can be further developed.



## **GS9-11 Design and Development of Three Arms Transmission Line Inspection Robot**

Muhammad Fairuz Abdul Jalal, Khairul Salleh Mohamed Sahari, Ho Ming Fei, Justin Chan Tuck Leong (Universiti Tenaga Nasional, Malaysia)

The high-voltage transmission line had been used primarily for power distribution from power plant or power station to the end users. However, the transmission line is highly prone to damage due to exposure to various thermal - mechanical loading and material degradation. Therefore, periodical inspection on transmission line after prolonged service is needed to prevent any failure before it happens. In this paper, we present a new design of three arms inspection robot for transmission lines. The robot is able to transverse along the line and bypass the in-line obstacles namely the anti-vibration hammers, spacer, strain clamps and others. The design of the inspection robot in term of the robot design and configuration with slotted cam at each arm is presented. The detailed analysis via simulation with respect to the robot stability; kinematic and movement analysis; and power consumption during operation is executed to make sure the proposed design able to do the inspection without any unexpected difficulties. Later, the lab testing on the developed prototype is done for feasibility study and validation.



## GS10 Others (4)

### GS10-1 A review on fundamental advancements of black hole algorithm

Zuwairie Ibrahim, Suad Khairi Mohammed, Norazian Subari

(Universiti Malaysia Pahang, Malaysia)

Nor Azlina Ab Aziz, Nor Hidayati Abdul Aziz(Multimedia University, Malaysia)

Tasiransurini Ab Rahman(Universiti Tun Hussein Onn Malaysia, Malaysia)

Asrul Adam, Zulkifli Md Yusof(Universiti Malaysia Pahang, Malaysia)

Mohd Ibrahim Shapiai

(Malaysia Japan International Institute of Technology, Universiti Teknologi Malaysia, Malaysia)

Norrima Mokhtar(University of Malaya, Malaysia)

In recent years, there is a growing interest in the design and development of nature-inspired optimization algorithms. One of the algorithms is black hole algorithm (BHA), which is inspired by the black hole in general relativity and cosmology. This paper reports a review of the BHA. This review emphasizes on the fundamental advancements of BHA. A brief research gap is presented at the end of this paper.

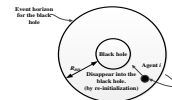


Fig. 1. Illustration of a black hole with its event horizon.

### GS10-2 A survey on applications of black hole algorithm

Zuwairie Ibrahim, Suad Khairi Mohammed, Norazian Subari, Asrul Adam, Zulkifli Md Yusof

(Universiti Malaysia Pahang, Malaysia)

Nor Azlina Ab Aziz, Nor Hidayati Abdul Aziz(Multimedia University, Malaysia)

Tasiransurini Ab Rahman(Universiti Tun Hussein Onn Malaysia, Malaysia)

Mohd Ibrahim Shapiai

(Malaysia Japan International Institute of Technology, Universiti Teknologi Malaysia, Malaysia)

Norrima Mokhtar(University of Malaya, Malaysia)

In recent years, there is a growing interest in the design and development of nature-inspired optimization algorithms. One of the algorithms is black hole algorithm (BHA), which is inspired by the black hole in general relativity and cosmology. This paper reports a review of the black hole algorithm (BHA). This survey emphasizes on the applications of BHA.

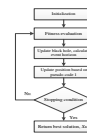


Fig. 1. Flowchart of BHA.

### GS10-3 Black hole white hole algorithm with local search

Zuwairie Ibrahim, Suad Khairi Mohammed, Norazian Subari, Asrul Adam, Zulkifli Md Yusof

(Universiti Malaysia Pahang, Malaysia)

Nor Azlina Ab Aziz, Nor Hidayati Abdul Aziz(Multimedia University, Malaysia)

Tasiransurini Ab Rahman(Universiti Tun Hussein Onn Malaysia, Malaysia)

Norrima Mokhtar(University of Malaya, Malaysia)

Black hole algorithm (BHA) is an optimization algorithm inspired by the black hole discovery in relativity theory. Recently, white hole operator, which is based on the opposite of black hole, has been introduced in BHA. In this paper, a local is added in the BHA with white hole operator.

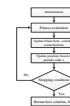


Fig. 1. Flowchart of BHA.



## GS10-4 Tele-Operation of a Legged Robot by a Virtual Marionette System - First report: The first prototype and the usefulness of the reaching task-

Noritaka Sato, Yasuhiko Sawai, Ryo Asami, Makoto Kitani, Yoshifumi Morita  
(Nagoya Institute of Technology, Japan),

Tomofumi Fujiwara, Takahiro Endo, Fumitoshi Matsuno (Kyoto University, Japan)

In general, a gamepad and images from a camera mounted on a robot are used for the teleoperation of a rescue robot. However, teleoperation is difficult for inexperienced users because the relationship between the user input and robot motion is not always intuitive. Therefore, we have developed an interface in which the operator operates a robot as if touching it directly in a virtual 3D space. In our previous research, we developed a virtual direct teleoperation system for a tracked rescue robot. In this study, we adapt our system to inputting target positions of a hand or a foot of a legged rescue robot. We verify the effectiveness of the proposed system by comparison with the conventional method which is used by the team participating in the DARPA Robotics Challenge.

