ABSTRACTS

Plenary Speech 1 (Room G)

January 18 (Thursday), 13:25-14:15

Chair: Fumitoshi Matsuno (Kyoto University, Japan)

Helping a Robot to Understand Human Actions and Objects

Florentin Wörgötter
(University of Göttingen, Germany)

Humans are able to perform a wide variety of complex actions manipulating a very large number of objects. We can make predictions on the outcome of our actions and on how to use different objects. Hence, we have excellent action&object understanding. Artificial agents, on the other hand, still miserably fail in this respect. It is particularly puzzling how inexperienced, young humans can acquire such knowledge; bootstrapped by exploration and extended by supervision. In this study we have, therefore, addressed the question how to structure the realm of actions and objects into dynamic representations, which allow for the easy learning of different action and object concepts. Performing different manipulation actions on a table top (e.g. the actions of “making a breakfast”), we show with our robots that this will indeed lead to some kind of implicit (un-reflected) understanding of action and object concepts allowing the agent to generalize actions and redefine object uses according to need.

Biography:

Florentin Wörgötter studied biology and mathematics at the University of Düsseldorf, Germany. He received a Ph.D. degree, studying the visual cortex, from the University of Essen, Germany, in 1988. From 1988 to 1990, he did research in computational neuroscience at the California Institute of Technology, Pasadena. He became a Researcher with the University of Bochum, Germany, in 1990, where he was investigating experimental and computational neuroscience of the visual system. From 2000 to 2005, he was a Professor for computational neuroscience with the Psychology Department, University of Stirling, U.K., where his interests strongly turned towards “Learning and Adaptive Artificial Systems” Since July 2005, he has been the Head of the Computational Neuroscience Department at the Bernstein Center for Computational Neuroscience, Inst. Physics 3, University of Göttingen, Germany. His current research interests include information processing in closed-loop perception–action systems (animals, robots), sensory processing (vision), motor control, and learning/plasticity, which are tested in different robotic implementations. This work has recently turned more and more towards issues of artificial cognition addressing problems of human action and object understanding and how to transfer this to machines.

Plenary Speech 2 (Room G)

January 19 (Friday), 11:00-11:50

Chair: Hiroshi Tanaka (Tohoku Medical Megabank Organization, Tohoku University, Japan)

Engine-verseology: a new mathematical physics solving 100-year-old mysteries of subatomic, biological, cerebral, cosmic, and mechanical engines in the universe and engendering versatile technologies on medicine, information, energy, and mobility

Ken Naitoh
(Waseda University, Japan)

Phenomena in the universe are mathematically and physically similar to those in a small mechanical engine: expansion flow during engine combustion and the Big Bang and breakup of flexible particles such as fossil fuel droplets, biological cells, biological molecules, stars, and subatomic ones.

This eye-opening idea of similarity and two mathematical principles on indeterminacy and stability posit new stochastic differential equation systems lying between the Boltzmann, Langevin, and Schroedinger ones for explaining the mysteries of subatomic, biological, mechanical, and cosmic engines and also bringing their solutions. This approach leads to seven interdisciplinary sciences: (1) Quantum fluid mechanics, (2) Computational statistical fluid mechanics for solving transition phenomena, (3) Cyto-fluid dynamics that can explain the proliferation, differentiation and replication of biomolecules, (4) Onto-biology that clarifies the relationship between information, structure, and function, (5) Hyper-gourd theory that clarifies masses of particles such as quarks and leptons related to the super-magic numbers, including the asymmetric silver ratio and symmetric yamato ratio (aqua ratios), and also reveals further mechanisms underlying symmetry breaking, (6) Bio-standard network theory describing the standard network pattern of somatic and neural cells and biological molecules, and (7) Morpho-psychological economics for dodging catastrophes. Thought and computer experiments based on the seven sciences and actual experiments also show possibilities for engendering three technologies of a Big Bang-like engine (Fugine & Fusine) with very high thermal efficiencies due to nearly complete air-insulation and nuclear condensed matter for versatile usages on the ground and in aerospace, universal medicine against aging (Prognostic medicine), and an artificial ageless genius for creating soothing music and verse (Agenius).

Thus, “Engine-verse-ology” is a new hyper-interdisciplinary physics that explains a very wide range of scales and also provides driving force for evolving the universe, which leads to two quantum leaps from complexity research in a labyrinth to ultimacy exploration in paradise and also from innovation to invention.

Biography:

1985: B.D. Waseda University
1987: M.D. Waseda University
1987-2000: NISSAN Motor Co., Ltd.
1993: Phd. Waseda University
2000-2005: Associate Professor, Yamagata University
2005-: Professor, Waseda University
1992: Best paper award of Japan Society of Automotive Engineers (JSAE)
1993: Best paper award of Japan Society of Mechanical Engineering (JSME)

January 18 (Thursday), 09:00–10:15

Room A

GS18 Robotic Mechanism

Chair: Shinichi Sagara (Kyushu Institute of Technology, Japan)

GS18-1 SENSAR: An Interactive Sociable Robotic Photographer

Udaka A Manawadu[1], Didula C Egodage[1], H Thilina M Perera[1], Lakshitha Madushan[1],
Damith C Herath[2], P Ravindra S De Silva[1]
([1]University of Sri Jayewardenepura, Sri Lanka)
([2]University of Canberra, Australia)

Parents and caretakers are interested in recording the activities of their children, especially behavioral expressions as photographs throughout the various growth stages, a documented memory of how they have grown. Since, SENSAR robot is capable to capture children's natural expression as a photographer while motivating to interact with robot. This robot is capable to establish long term engagements with children by changing interactive patterns by considering children's activities, reactions and behaviors in real time. As a preliminary experiment, we have explored the effectiveness of the robot's interaction through two design aspects of the robot, animacy and anthropomorphism. In this experiment, 20 caregivers participated with their children for five minutes per interaction. After the interaction, they were given a questionnaire spanning the above factors to evaluate the effectiveness of the robot. Results show that the robotic platform is highly effective as an interactive photographer to capture children's natural expression.

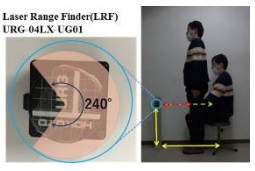
GS18-2 Development of modular underwater vehicle using underwater wireless communication

Yoshiharu Mizuki[1], Masayoshi Ozawa[2], Gaiki Yoshizawa[1], Etsuro Shimizu[1]
([1]Tokyo University of Marine Science and Technology, Japan)
([2]Mitsui Engineering & Shipbuilding Co., Ltd, Japan)

In this paper, we developed a modular underwater vehicle using underwater radio communication method. MQTT (Message Queue Telemetry Transport) with high speed and small capacity is adopted as a communication protocol. The proposed underwater vehicle consists of server modules, client modules and gateway modules. In addition the construction of the network is modified. As a result of the operation test, any problems in the operation of the module underwater vehicle and the significant delay in communication between the modules are not observed. The measurement result of the communication speed showed that the communication speed is not decreased when the modules were attached and detached.

GS18-3 Assist Device of Standing/Sitting Behaviors by Using Relative Distance Differences

Takuma Idogawa, Geunho Lee, Masaki Shiraishi, Soe Htet Hein
(University of Miyazaki, Japan)

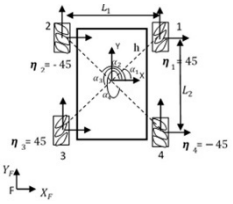


Elderly people generally tend to behave slowly and the reaction time is delayed; moreover, not many are familiar with mechanical or electronic controls. Therefore, when designing and developing a standing-up and sitting-down assist device for the elderly, an easy-to-learn and simple-to-use interface system capable of responding to complex and diverse environments is of particular importance. Next, the device is expected to employ in various kinds of public places. More than anything, protection of personal information is one of its fundamental requirements. For this purpose, our paper tackles a problem of designing a user interface between an elderly user and the assist device for standing and sitting behaviors. As an essential functionality, the paper introduce a novel distance-based interface scheme, allowing to recognize these 3-D behaviors and generate the device's motions corresponding to the recognized behaviors without requiring any additional user inputs.

January 18 (Thursday), 09:00–10:15

GS18-4 Feedback Controller Design of Four Mecanum Wheeled Mobile Platform

Soe Htet Hein, Geunho Lee, Takuma Idogowa, Takashi Yoshiura
(University of Miyazaki, Japan)



Mecanum wheel is a complex design wheel and mobile robots with this wheel have the omnidirectional property. The main objective of this research is to develop kinematic model, dynamic model (using lagrange's equation) of four mecanum wheeled mobile platform. In order to successfully reach the robot's target position to the predefined trajectory, control mechanism will be needed. For implementing this mechanism, the most popular type of feedback controller design such as Proportional-Integral-Derivative (PID) controller will be applied. Simulation is an essential part of the research, so most of the control systems will be tested in simulations by using Matlab/Simulink before being applied to the real/physical experiments and the research results obtained will be used for developing new concepts for the lower limb assist robotic walker.

GS18-6 Design and implementation of a mosquito capturing autonomous robot

Chung W. Lee, Wei J. Tsai, Yu H. Chung, Yi H. Kung, Ping J. Su, Jung H. Chou
(National Cheng Kung University, Taiwan)

This study develops a mosquito capturing mobile robot which can overcome the rough terrain which includes gravel and sandy terrain using a rocker-bogie mechanism. The brain of this robot platform is microcontroller dsPIC30F4011 which can drive motors to move and process signals received from the sensors. The way to communicate with every microcontroller is by CAN Bus, except the personal computer and the main microcontroller. These latter two communicate via RS232. Both ranging laser and Global Positioning System (GPS) are used for localization. Mosquitoes are captured by a cyclone structure with attractants and infectious ones are recognized by image processing through the black-and-white-striped feature of their bodies. By combining the color detection and feature detection, the recognition rate of dengue and non-dengue mosquitos can reach 100%.

January 18 (Thursday), 09:00–10:15

Room C

GS19 Sensor and multi-sensor data fusion

Chair: Maki K. Habib (The American University in Cairo, Egypt)

GS19-1 Proposal of an Ultrasonic Sensor Array with Flexible and Scalable Organization

Yuichi Morita, Sota Kono, Akira Yamawaki
(Kyushu Institute of Technology, Japan)

In ultrasonic sensor array, the more number of sensors is, the more number of cables between the sensing part and the data processing part is. Reducing the cables however leads to decrease the resolution depending on the number of sensors. In addition, measured objects have different shape and size, so ultrasonic sensor array with the shape fitting to the target objects must be developed individually. To solve this problem, we propose the organizing method of the ultrasonic sensor array with constant number of cables independent to the number of sensors, whose sensors can be flexibility and scalability applied to arbitrary objects with different shape and size respectively. In this proposed structure, several ultrasonic sensors compose a block. The blocks are connected by serial communication with flexible connectors can be bending. In this paper, we develop a test bed hardware of the single block and verify the operation.

January 18 (Thursday), 09:00–10:15

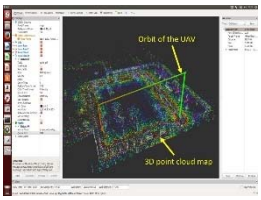
GS19-2 A consideration of accurate measurement for drone with cross-shaped laser

Hiroki Matsuzaki, Hirokazu Matsui, Norihiko Kato
(Mie University, Japan)

The localization method is proposed that consists of an upward cross-shaped laser from ground and a downward PSD (Position Sensitive Detector, that can detect the center of the light irradiated on the sensor surface) on the drone, and that the drone could move vertical along the cross point of laser. The horizontal plane (in which the drone exists) is divided into 4 quadrants by an upward cross-shaped laser. The drone can find the cross point of the laser lines, since it knows which quadrant it has moved to and that it should move to which direction, if it crosses a laser line as a part of cross-shaped laser. This provide new views in the field of measurement by drone, since it enables highly accurate measurements to be achieved using ordinary methods.

GS19-3 Performances of 3D mapping and odometry tools, and of a visualization system for analyzing accidents of unmanned aerial vehicles

Ryuhei Yamada, Yuichi Yaguchi, Masashi Yoshida
(The University of Aizu, Japan)



Our target is to replace the accident conditions of the unmanned aerial vehicles (UAVs) using data obtained from the sensors and flight recorder loaded on the UAVs to analyze their causes. In this paper, we have first investigated the performances of three types of tools for 3D mapping and odometry to reproduce the surrounding environment and its orbit, and found that the tool using the LIDAR data are more accurate and can reproduce broader areas compared with methods that use monocular and stereo camera images. Second, we applied an optical flow method to images taken by a monocular camera rotating with 4 types of velocities, and found that imaging over 120 fps is required to analyze accurately the velocity field of the rotating and falling UAV. Finally, we have developed a visualization system that displays the reproduced situations of the UAV flights and accidents on a computer screen.

GS19-5 Development of Ocean Observation System using a Long-range Wi-Fi

Gaiki Yoshizawa, Yoshiharu Mizuki, Ryuhei Kanno, Etsuro Shimizu, Takato Nagai
(Tokyo University of Marine Science and Technology, Japan)

Many Autonomous Underwater Vehicles (AUVs) and Remotely Operated Vehicles (ROVs) have been developed. Since those underwater vehicles are basically expensive, a new ocean observation system which is not expensive is proposed. This system is floated easily and transmits observation date using Wi-Fi from the sea. In this paper, an experimental model of the ocean observation system is manufactured and experiments with the manufactured system are carried out.

January 18 (Thursday), 09:00–10:15

GS19-6 Development of navigation information sharing system for unmanned boat

Motoki Yamaguchi[1], Etsuro Shimizu[1], Ayako Umeda[1], Tsuyoshi Oode[1], Tomoji Takamasa[2]
([1]Tokyo University of Marine Science and Technology, Japan)
([2]National Institute of Technology, Toyama college, Japan)

An unmanned operation of ships is an effective method for improving the working environment of seafarers, solving the shortage of seafarers and improving the efficiency of marine surveys. Nevertheless, the reason why the development of unmanned technologies is delayed is that a ship is more affected by disturbances than shore systems, a communication line for remote monitoring is not stable and a simplified system to be installed to existing small ships does not exist.
In general, the marine vessel maneuvering is carried out by human operators using almost of all information obtained through their five senses and their experience. However, since the unmanned maneuvering from the remote location has to be carried out by using the limited information obtained from the screen, this type of maneuvering is difficult compared with the conventional operation. The aim of this research is to support a marine vessel operator, construct a remote control system that gathers data of vessels sailing on the water using Wi-Fi and a visual display system to operators.

January 18 (Thursday), 09:00–10:15

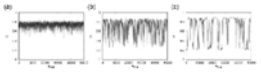
Room D

OS10 Protocomputing

Chair: Moto Kamiura (Tokyo Denki University, Japan)
Co-Chair: Kazuto Sasai (Tohoku University, Japan)

OS10-1 Uncertainty of the second order - Quasispecies model with inverse Bayesian inference -

Taichi Haruna
(Tokyo Woman's Christian University, Japan)



We study the stochastic dynamics of the quasispecies model with inverse Bayesian inference under environmental uncertainty. Inverse Bayesian inference is introduced through the correspondence between Bayesian inference and the replicator equation. We consider environmental uncertainty that is not modeled as the stochastic fitness which we call uncertainty of the second order. This is in contrast to uncertainty of the first order that can be subsumed by the stochastic fitness. The difference between these two kinds of uncertainty is discussed in the framework of categorical Bayesian probability theory. We analytically show that if the time-scale of inverse Bayesian inference is sufficiently larger than that of Bayesian inference, then the quasispecies model exhibits a noise-induced transition. The theoretical result is verified by numerical simulation.

January 18 (Thursday), 09:00–10:15

OS10-2 Are word learning biases based on symmetry in cognition?

Takumi Kamiya, Tatsuji Takahashi
(Tokyo Denki University, Japan)

Most machine learning systems require huge amounts of data/trial-and-errors, and the flexibility of learned knowledge is compromised. In contrast, humans have rapid learning capabilities from small data. It is known that the fast-mapping requires several constraints to the hypothesis space. It is also known that certain symmetry found in human cognition is extremely hard to find in other animals. Understanding how the biases and constraints appear, work and disappear will contribute to the making of grounded symbols. In this study, we study how the word learning biases and the symmetry in cognition are related, using simulations of infants' simple word learning tasks. The results suggest that word learning is promoted by the symmetry and it is deeply involved with the emergence and mutual adjustments of the biases. It is also suggested to contribute to generalization of the learned correspondence between the attribute of the objects and labels onto uninstructed labels.

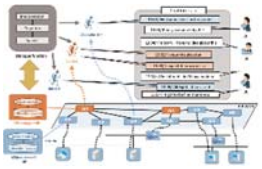
OS10-3 Causal induction under rarity and small data

Junki Yokokawa[1], Kuratomo Oyo[2], Tatsuji Takahashi[1]
([1]Tokyo Denki University, Japan)
([2]Kwansei Gakuin University, Japan)

In this paper, we focus on how humans calculate the causal strength between two events from small data. Causal strength is the intensity of causality between two events, a candidate cause and an effect in focus. Through the evolutionary history, human beings have adapted to changes in the environment. This would be impossible without the ability to clarify the causal structure among various events and to measure the strength of the causal relationships. Hence, it would be beneficial for understanding of human cognition, and especially its adaptable nature, to computationally understand how humans learn and exploit causal relationships of the world. Regarding the mental model of the causal structure, it has become possible to model it well by the development of the Bayesian networks. However, the model of how humans inductively construct the causal strength is not given the definite form.

OS10-4 Collective interaction between humans and agents in the network management tasks

Kazuto Sasai, Takuya Hoshino, Gen Kitagata, Tetsuo Kinoshita
(Tohoku University, Japan)



Expansion of the networking raises the burden of the users in the edge network where there is no full-time network engineer. In particular, under a disaster situation, the absent of professional engineer is more possible matter regardless of the network scale. These problems occur when there is a knowledge gap between full-time worker and occasional worker. This paper discusses about human-agent collaboration to improve the gap by the new functionality of agents according to the concept of Human-Agent Collectives, HAC. We propose a dialogue function for the chat-based interaction with the human administrators and implement to the AIR-NMS, an intelligent, autonomous network management support system. Through the evaluation experiment, we confirmed that the collective interaction via dialogue function makes the network management tasks to be easy even if the non-professional administrators. The result supports the possibility to solve the knowledge gap.

January 18 (Thursday), 09:00–10:15

OS10-5 Statistical Analyses on Used Car Market of Japan

Moto Kamiura, Shinya Hoshi
(Tokyo Denki University, Japan)

The objective of the present study is to statistically analyze the data of a Japanese market of used cars published on a web site, and to check whether the statistics derived from the data show behavior as estimates of macroeconomic indicators. For the objective, we developed a web scraping system for web page acquisition and data reduction on used car market. This system consists of web crawler and HTML parser. An ID number is assigned for data of one used car, to avoid double count. We can obtain CSV file data of 60-70 MB per day, and each CSV file has about 300 thousand cars data. The time series of stocks and outflow of the used cars, and the distributions of them, show macroeconomic change of Japan.

January 18 (Thursday), 09:00–10:15

Room E

GS1 Agent-based modelling

Chair: Keita Nakamura (University of Aizu, Japan)

GS1-1 Effects of the Dilemma between Reactiveness and Proactiveness Incorporated in Empathic Caribou Agents on Evolution of their Escaping Behavior in the Wolf-caribou Problem

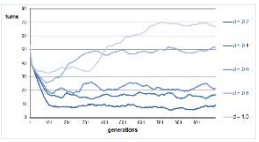
FangWei Huang, Ivan Tanev, Katsunori Shimohara
(Doshisha University, Japan)

We investigate whether trade-off between reactive and proactive behaviors – implemented in caribou agents improves the efficiency of the simulated evolution (via genetic programming) of their escaping behavior or the effectiveness of such a behavior in the wolf-caribou predator prey pursuit problem (WCP). The latter comprises a team of inferior caribou agents attempting to escape from a single yet superior (in terms of sensory abilities, raw speed, and maximum energy) wolf agent in a simulated two-dimensional infinite toroidal world. We conducted several experiments to investigate the dilemma between the reactiveness and proactiveness of the behavior of caribou agents. The experimental results suggest that the trade-off between the reactiveness and proactiveness facilitates a significant improvement of both the efficiency evolution and the effectiveness of the evolved escaping behavior of caribou agents.

GS1-2 Optimization of mating strategy for damselflies by sexual selection

Ryo Miyabe, Atsuko Mutoh, Koichi Moriyama, Nobuhiro Inuzuka
(Nagoya Institute of Technology, Japan)

Evolutionary game theory enables the study of behavior from an evolutionary standpoint for optimal strategies under defined conditions. Although Ischnura senegalensis behavior has been simulated by focusing on the maintenance of female color diversity, few studies have focused on modeling sexual selection and sperm competition. In this study, we propose an evolutionary model focusing on mating time and simulated male optimal mating strategies. As a result, in the morning before spawning activities, males evolved to mate for a long time compared with the afternoon. This showed that mating for a long time is an optimal strategy to prevent their sperm from being scraped out by other males.

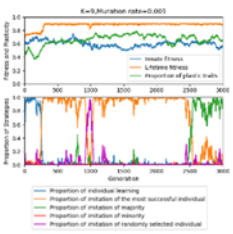


January 18 (Thursday), 09:00–10:15

GS1-3 The Evolution of Individual and Social Learning Strategies on Rugged Fitness Landscapes

Daiki Tozuka, Reiji Suzuki, Takaya Arita
(Nagoya University, Japan)

Social animals including humans perform social learning which has many strategies, but little is known about the roles of them in the interactions between evolution and learning. This study investigated the roles of them under the coevolution of individual learning and several types of social learning strategies on NK fitness landscapes. We found that individual learning tended to spread in the early stage of evolution, especially in landscapes with high epistasis (rugged landscapes). As the population approaches and converges on a peak, one of the social learning strategies except imitation of minority becomes to spread, leading the population to acquire the high fitness which could not be acquired by individual learning alone. We also show that each social learning strategy has unique roles in evolution and any social learning strategy is not evolutionary stable.



GS1-4 Introducing persistent-defect strategy promotes the evolution of cooperation

Tomoyuki Nishigata, Reiji Suzuki, Takaya Arita
(Nagoya University, Japan)

Humans are uniquely altruistic. Many researches have been investigated the evolutionary process of acquiring such traits. Iterated prisoner's dilemma game (IPD) is a powerful tool to solve that question. This study adds an extension to the representation of strategies in IPD to investigate players' persistent attitude, and observes its effects on the evolution of cooperation. Specifically, we introduce a continuous move that continues to cooperate (or defect) a fixed number of times independent of the moves of the other player. The results show that introducing continuous defection significantly promotes the cooperation. Our analysis of the evolution of strategies shows that continuous defection can function as punishment to defectors and improve robustness of the dominant cooperative strategies in the population.

GS1-5 Solving the shortest path problem with the algorithm of the potential divider method

Thammarat Taengtang
(King Mongkut's of Technology Ladkrabang, Thailand)

Nowadays, there are a number of grading applications that desire the use of heuristic shortest path algorithm rather than one of the standard algorithms. Both immediate response and repeated calculation of shortest path algorithm are primary requirements of some transportation application. So the decreasing the computation time of the shortest path algorithm has been developed to advocate this reason. This paper proposes a fundamental knowledge of electronic circuit on potential divider to establish the shortest path algorithm. When begin vertex and destination vertex has been assigned, this method has created the basic equations to sort each vertex. The objective is to present the new algorithm that is different from the standard algorithm.

January 18 (Thursday), 10:45–12:00

Room A

OS9 Modeling and Control of Motion

Chair: Shinichi Sagara (Kyushu Institute of Technology, Japan)
Co-Chair: Masahiro Oya (Kyushu Institute of Technology, Japan)

OS9-1 Improved Wrist Joint Dynamics with Myoelectric Signal inputs

Shu Inoue[1], Keshiki Terada[1], Hidetaka Ohta[1], Yuichiro Taira[2], Masahiro Oya[1]
([1]Kyushu Institute of Technology, Japan)
([2]Sojo University, Japan)

There are a lot of studies to develop prosthetic hands. We have been developing the wrist joint dynamic model which can describe human wrist joint dynamics from amplitudes of surface electromyogram signals on hands to wrist joint angle. However, the wrist joint model has the problem that the model cannot reproduce steady behavior of human wrist joint angle when wrist joint moving is slow or kept at a specified joint angle. To address the problem, we will develop a modified wrist joint model. In the model, amplitudes of myoelectric signals are considered as a desired angular velocity. To verify usefulness of the wrist joint model, experiments are carried out. As a result, it is shown that the developed wrist joint model is very useful.

OS9-2 Position Control of Multirotor Helicopter with a Wind Disturbance

Naoki Matsuo[1], Hideki Wada[2], Katsuhiro Okumura[3], Masahiro Oya[1]
([1]Kyushu Institute of Technology, Japan)
([2]Shin-Nippon Nondestructive Inspection Co., Ltd, Japan)
([3]Fukuoka Industrial Technology Center, Japan)

In this paper, we propose a position controller for multirotor helicopters with a wind disturbance. Conventional position control methods can ensure good control performance on the position tracking error with a wind disturbance. On the other hand, vibrations occur in the helicopter angles due to wind disturbances. In such a case, human operators misunderstand the situation such that the control system may be unstable. In such a case, human operators may do an erroneous operation, and then, the helicopter may become unstable. To address this problem, we propose a new position controller without high frequency angular vibration of a helicopter. To show the effectiveness of proposed controller, numerical simulations are carried out.

OS9-3 Resolved acceleration control of a 3-link dual-arm underwater robot - Simulation for underwater robot gripping fixed underwater object with one hand -

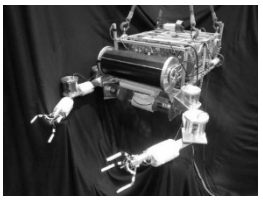
Shingo Yamamoto[1], Takayuki Kawaguchi[1], Shinichi Sagara[1], Radzi Amber[2]
([1]Kyushu Institute of Technology, Japan)
([2]Universiti Tun Hussein Onn Malaysia, Malaysia)

We proposed a resolved acceleration control (RAC) method for Underwater Vehicle-Manipulator Systems (UVMS) which is a position control method and the usefulness of the RAC method has been verified through experiments. We also proposed force control for UVMS and confirmed the effectiveness of force control method by simulation. In the simulation, the force control method was verified on the UVMS, where the proposed force control method was applied to the control of right manipulator, and RAC method was applied to the left manipulator and the vehicle. If one hand can grip on a fixed underwater object and can perform task with the other hand, the vehicle instability can be suppressed. In this paper, by setting the position of a fixed object as the target value for the right hand, the effectiveness of RAC method during the condition where an hand gripping a fixed object were verified through simulations.

January 18 (Thursday), 10:45–12:00

OS9-4 Impedance control of a 3-link manipulator mounted on position-controlled floating underwater robot by resolved acceleration control method

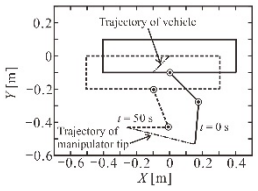
Yutaka Seki[1], Yuichiro Taira[2], Shinichi Sagara[1], Radzi Amber[3]
([1]Kyushu Institute of Technology, Japan)
([2]Sojo University, Japan)
([3]Universiti Tun Hussein Onn Malaysia, Malaysia)



Ocean development has been carried out for various purposes such as construction and mining of natural resources. However, underwater activities are dangerous to humans due to the harsh environment. In order to solve this problem, various research studies on underwater robotic systems called Underwater Vehicle-Manipulator System (UVMS), which are robots equipped with multiple manipulators are currently underway globally for the purpose of supporting and substituting humans. Since, most of underwater tasks involve interaction with the environment. Therefore, it is considered necessary to develop not only position control method, but also force control method for UVMS. Therefore, we also aim at developing a force control method for UVMS by considering the robot dynamics. As the first step, a force control method based on impedance control has been developed. This paper reports the results of the numerical simulations to show the effectiveness of the proposed force control method for UVMS.

OS9-5 Design of a motion and force controller based on impedance control for underwater-vehicle manipulator systems including thruster dynamics

Yuichiro Taira[1], Shinichi Sagara[2], Masahiro Oya[2]
([1]Sojo University, Japan)
([2]Kyushu Institute of Technology, Japan)



This paper deals with a motion and force control scheme for underwater robots equipped with manipulators. The authors have proposed a hybrid motion and force controller. However, this controller may be unsuitable for a subsea operation that requires a contact between the manipulator and an environment with a soft or fragile surface, because the design is based on the assumption that a contact surface is rigid. For such an operation, it is desirable that the stiffness of a mechanical impedance is sufficiently low. In this paper, we develop a motion and force control scheme based on impedance control, which can achieve a desired mechanical impedance. It is theoretically shown that all signals in the control system are bounded, and the mechanical impedance is adjustable to a desired one. The results of the theoretical analysis are supported by those of numerical simulations.

January 18 (Thursday), 10:45–12:00

Room B

OS5 Computational methods for Human Biological information

Chair: Tomoyuki Hiroyasu (Doshisha University, Japan)
Co-Chair: Hiroshi Furutani (Doshisha University, Japan)
Co-Chair: Satoru Hiwa (Doshisha University, Japan)

OS5-1 Optimization of electrode placement and frequency band selection using a genetic algorithm during EEG-based motor imagery brain computer interfaces

Satoru Hiwa, Tomonori Ishihara, Hiroshi Furutani, Tomoyuki Hiroyasu
(Doshisha University, Japan)

EEG-based BCI is a technology to control the external device by brain activity without any physical behavior. However, in using the motor imagery BCI, it is necessary to arrange a large number of EEG signal measurement CHs. Also, the optimum bandwidth of the bandpass filter used for preprocessing has a great influence on the classification accuracy. In the present study, we try to reduce this burden by optimizing it that the channels to acquire EEG signals and the bandpass filter used in processing. In the proposed method, EEG measurement channel selection and the selection of the bandwidth of the filter used in the preprocessing are solved by NSGA-II. In order to evaluate the effectiveness of the proposed method, the experiment was conducted. The result shows that the motor imagery classification accuracy could be improved and chose CH positions and frequency bands strongly related to the task.

OS5-2 Phantom development for examining dynamic influence between fNIRS channels

Satoru Hiwa, Shuhei Yokoyama, Hiroshi Furutani, Tomoyuki Hiroyasu
(Doshisha university, Japan)

In this paper, we developed a phantom for fNIRS (functional Near Infra-Red Spectroscopy) which has a simple structure with optical properties similar to those of living tissue and has multiple channels. By constructing a dynamic model of the developed phantom and identifying existing parameters from the experimental data, the dynamic influence between the channels can be considered.

OS5-3 Cell quality evaluation by flattening of cultivated human corneal endothelial cells

Satoru HIWA, Keitaro KOBAYASHI, Naoki OKUMURA, Noriko KOIZUMI,
Hiroshi FURUTANI, Tomoyuki HIROYASU
(Doshisha university, Japan)

One method of corneal regenerative medicine is culturing corneal endothelial cells (CEC) and transplanting them to a patient. At present, experts evaluate the quality of cultured human corneal endothelial cells (HCEC) visually by culture indicators such as shape, density, and area variation, however, this visual inspection is difficult and time consuming. For that purpose, we present a system that automatically quantifies the culture quality indicators from cultured HCEC images. It is assumed that only cultured HCEC images are used. In the culturing of CECs, HCECs termed fibroblast-like cells (FLC) are transformed, and it is difficult to detect the cells in which the function of CEC is lost. In this work, flattening was proposed as a culture index showing the difference in shape between cultured HCEC and FLC, and the reliability of this index was investigated. The flattening index is shown to determine statistically significant differences between HCEC and FLC.

January 18 (Thursday), 10:45–12:00

OS5-4 Investigation of detection method of fibroblast-like cells in cultured corneal endothelial cell image～Study of reliability and validity of flattening and area～

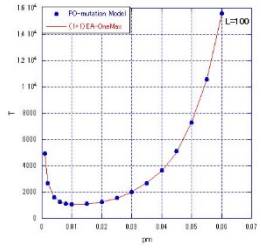
Tomoyuki Hiroyasu, Misato Saito, Keitaro Kobayashi, Naoki Okumura, Noriko Koizumi,
Hiroshi Furutani, Satoru Hiwa
(Doshisha University, Japan)

Increasing attention is given to corneal endothelial regenerative medicine culturing and transplanting corneal endothelial cells(CECs). Cultivated human CECs(HCECs) consist of both transplantable normal CECs and non-transplantable fibroblast-like cells(FLCs). Two cell types must be identified when using HCECs in corneal endothelial regenerative medicine. This identification is visually conducted by experts, but this is burdensome. In this system we have constructed to alleviate this by evaluating the quality of HCECs using images, flattening was initially proposed as an index for evaluating the quality of HCECs. However, normal CECs and FLCs couldn't be efficiently distinguished on the basis of flattening alone. This study proposes simultaneously considering flattening, area, and cell shape as indexes for evaluating quality of transplantable cells. By linear discriminant analysis, cell discrimination was conducted while identifying the presence or absence of FLCs and the effectiveness of each of the proposed indices of determination was examined.

OS5-5 Markov Chain Analysis of Evolutionary Algorithms for Monotonic Functions

Yu-an Zhang[1], QinLian Ma[2], Hiroshi Furutani[3], Satoru Hiwa[3], Tomoyuki Hiroyasu[3]
([1]Qinghai University, China)
([2]University of Miyazaki, Japan)
([3]Doshisha University, Japan)

The theoretical investigation of evolutionary algorithms (EAs) have increased our knowledge of the computational mechanism of algorithms. In this paper, we report the convergence properties of an algorithm that is a variant of (1+1) EA, partially-ordered evolutionary algorithm (PO-EA), which was initially designed for representing the evolutionary behaviors of all linear functions. Recently, PO-EA is expected to give a model for deriving an upper bound on the expected hitting time of EA for monotonic functions. A monotonic function is a pseudo-Boolean function whose value increases by flipping positive number of zeros to one. This study makes use Markov chain model to analyze the movement of PO-EA. We divide PO-EA into two parts, PO-mutation and ZeroMax EAs, and study their mutation rate dependences of the expected hitting times.



January 18 (Thursday), 10:45–12:00

Room C

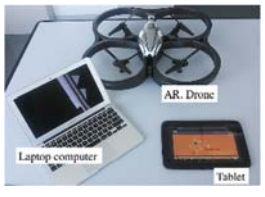
GS13 Motion planning and navigation

Chair: Reiji Suzuki (Nagoya University, Japan)

GS13-1 Design of campus navigation system using drone

Hironori Hiraishi
(Ashikaga Institute of Technology, Japan)

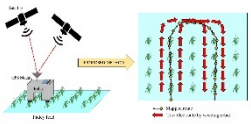
This paper describes the design of a campus navigation system using a drone. Recently, various types of unmanned aerial vehicles known as drones have been developed worldwide. The most important advantage of drones over conventional helicopters is probably their flying stability. This allows us to expect an increase in their availability. In contrast to wheeled or legged robots, drones can fly without distinguishing between passages and stairs. Therefore, we use the advantages of drones to realize campus navigation. Our drone traces a white line drawn on the floor and stairs that is detected through its lower camera. Some AR (Augmented reality) markers are placed at the guidance points on the white line. When the drone detects a marker, it hovers above that point and displays the information of the position on the tablets of users. The results of this study suggest that a drone can be used as campus navigation.



January 18 (Thursday), 10:45–12:00

GS13-2 Mapping of Traveling Route of a Paddy Weeding Robot Using GPS Coordinates

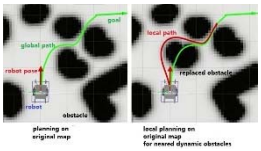
Kesevan Veloo[1], Hitoshi Sori[1], Hiroyuki Inoue[1], Hiroyuki Hatta[2], Yasuhiro Ando[2]
([1]National Institute of Technology, Tsuyama College, Japan)
([2]IKOMA Robotech Corporation, Japan)



A paddy weeding robot has been proposed for weed management. The robot may deviate while traveling depending on the conditions of soil surface. The aim of this study was to find a method that can monitor the route traveled by the robot. Thus, the method of mapping the traveling route of the paddy weeding robot using GPS (Global Positioning System) coordinates was proposed. A route mapping experiment was conducted in a harvested paddy field. While the user traveled in similar routes to the routes traveled by the paddy weeding robot, the GPS coordinates are obtained with a GPS module. From the obtained data, traveled routes were mapped and analyzed. Based on the results, we can confirm that it is possible to map traveled routes in paddy fields of different shapes and sizes using the proposed method. Thus, monitoring of routes traveled by the robot can be made with this method.

GS13-3 Navigation of a mobile robot in a dynamic environment using a point cloud map

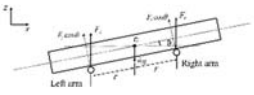
Xixun WANG[1], Yoshiki MIZUKAMI[2], Makoto TADA[3], Fumitoshi MATSUNO[1]
([1]Kyoto University, Japan)
([2]Yamaguchi University, Japan)
([3]BESTERRA CO., LTD, Japan)



In this paper we consider navigation of autonomous wheel mobile robots in a dynamic environment using a point cloud 3D map. As we consider a wheel mobile robot in a flat environment, a 2D environment map is sufficient for the robot. We generate a 2D real-time point cloud using 3D data from LiDAR and drop it into the horizontal plane of the static map using IMU sensor. To chart changes of the dynamic environment, a dynamic grid map is built by SLAM based on the static map. As an initial position/orientation of the robot is roughly given, the accurate initial position/orientation of the robot is calculated by ICP that matches a local map build by LRF and static map. Accumulated errors of SLAM can be canceled by using the landmark information. It is necessary to calculate the optimal path that the robot can move safely, smoothly and efficiently. Global planner calculates the optimal path that minimizes the distance from the robot position to goal position by A* algorism on the global cost map which is generated from the dynamic map. The TEB local planner is used to calculate an optimal path based on a local grid map given by real-time environment information from the LRF. To demonstrate the effectiveness of the proposed system, experiments by using an electric wheelchair based mobile robot were carried out. In the experiments, proposed system can navigate the robot in a dynamic environment and accumulated errors can be canceled by QR codes is attached on the environment as a landmark.

GS13-4 Stable Pulling Out Strategy for Small Disaster Response Robot with Dual-arm

Fumiaki Abe, Keita Nakamura, Jun Ogawa, Keitaro Naruse
(University of Aizu, Japan)

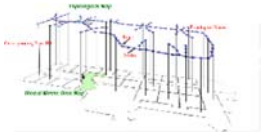


Many disaster response robots have been studied and developed to reduce the risk of secondary disaster. These robots are expected to improve efficiency and security. However, it is difficult for these robots to enter narrow spaces due to their size. Therefore, small disaster response robots are expected to remove debris. In this paper, we consider the task that a small disaster response robot pulls a bar whose length and mass are unknown stably out of a wall as debris removal. Pulling out motion involves a big problem that rotation center of the bar changes instantly and largely when it is left from a wall. Therefore, we propose stable pulling out motion to suppress rotation and translation. Experimental results show our proposal motion can stably pull out.

January 18 (Thursday), 10:45–12:00

GS13-5 Autonomous Mobile Robot Mapping and Navigation using Topological and Semantic Information

Ankit A. Ravankar, Abhijeet Ravankar, Yukinori Kobayashi, Takanori Emaru
(Hokkaido University, Japan)



For mobile robots to operate in indoor environment perception and mapping is an important task. Simultaneous Localization and Mapping or SLAM allows the robot to generate a map and ascertain its position in the environment using external sensors. This allows the robot to safely and autonomously navigate from one position to another without bumping into obstacles. One of the foremost challenges in this regard are limitations to the size of the environment that can be mapped with the inconsistencies and uncertainty arising due to sensor noise. In this paper we propose a hybrid topological semantic SLAM system that can map large areas for mobile robot exploration and navigation by combining metric and topological information. As compared to traditional approaches of robot mapping, the method is lightweight and can be used for mapping and navigation in large areas which is particularly useful for service robots operating in large buildings.

January 18 (Thursday), 10:45–11:45

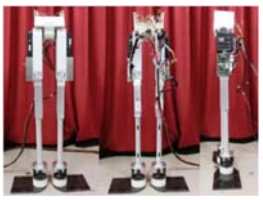
Room D

OS12 Robotics with Intelligence and/or Informatics 1

Chair: Mamoru Minami (Okayama University, Japan)
Chair: Tetsuya Kinugasa (Okayama University of Science, Japan)

OS12-1 3-D Dynamic Bipedal Walking Using Telescopic Knee Oscillation via TEGOTAE Approach

Tetsuya Kinugasa, Tomoki Tada, Yuki Yokoyama, Hor Jia Hui, Koji Yoshida, Ryota Hayashi, Takuya Miyagawa, Shinsaku Fujimoto
(Okayama University of Science, Japan)



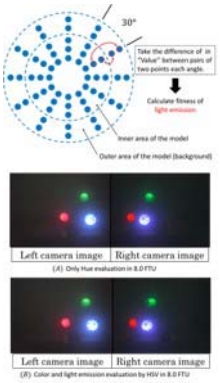
This study aims at realizing a 3-D dynamic bipedal walking using two oscillators of a CPG approach based on its body dynamics. First, we develop a 3-D biped that comprises flat feet with pressure sensors, ankle joints composed of ball joints surrounded by coil springs, telescopic knees, and active hip joints using a direct drive (DD) motor. A torso is controlled by the DD motors using a PD control scheme. Next, we introduce the Owaki-Ishiguro method called 'TEGOTAE based approach' as ground contact information in the phase oscillator to the knee joint. Finally, we conduct some experimental tests to elucidate effectiveness of the biped. As a result, we achieved 3-D dynamic bipedal gait of RW06 only by the knee oscillation based on the 'TEGOTAE' control scheme. The bipedal walking was excited only by the knee oscillation, therefore, the gait was strongly affected by the body dynamics.

January 18 (Thursday), 10:45–11:45

OS12-2 Improvement of 3D-Pose Real-time Estimation by Active Marker and HSV-evaluated Function

Daiki Yamada, Naoki Mukada, Myo Myint, Khin Nwe Lwin, Takayuki Matsuno, Mamoru Minami
(Okayama University, Japan)

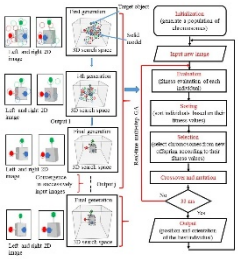
Nowadays, AUV is playing an important role for human society in different applications such as inspection of underwater structures (dams, bridges). Underwater recharging function is one of the solution to enable the AUV to operate for extended periods independently on a surface vessel. we have developed dual-eyes vision-based docking system especially for final docking step. The most challenging and unavoidable problems in sea operations are turbidity and light changing. In this study, we newly designed an active -light emitting- 3D marker and a fitness function determined by HSV color components to improve the performance of the system especially in a more turbid environment. We conducted docking operation using this system in a pool with dark and turbid water (8.0 FTU) for verifying utility of methods we proposed. The experimental results have confirmed the robustness of the docking system using the improved method against turbidity.



OS12-3 Pose Estimation by Optimizing Real-time Multi-step GA's Parameters

Khin Nwe Lwin, Myo Myint, Naoki Mukada, Daiki Yamada, Takayuki Matsuno, Mamoru Minami
(Okayama University, Japan)

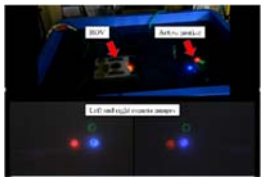
3D pose estimation using dynamic images input by video rate should be conducted in short time when the estimated pose would be used for real-time feedback control. Controlling with 3D pose estimated through single camera images has been studied so far ardently, but it has been confirmed that estimated position accuracy in camera depth direction is not enough. The authors have proposed a new 3D position and orientation (pose) estimation method with dual-eye cameras that exploits the parallactic nature that enables reliable 3D pose estimation in real-time, named as ``Real-time Multi-step Genetic Algorithm (RM-GA)." This paper focuses on improving dynamic performance of dual-eye real-time pose tracking by tuning parameters used in RM-GA, having confirmed that the dynamical performance in time domain to estimate target marker's pose in real-time has been optimized.



OS12-4 Docking Performance Against Turbidity Using Active Marker Under Day and Night Environment

Khin Nwe Lwin, Myo Myint, Naoki Mukada, Daiki Yamada, Takayuki Matsuno, Mamoru Minami
(Okayama University, Japan)

Nowadays, Autonomous Underwater Vehicle (AUV) is playing an important role for human society in different applications such as inspection of underwater structures. We have developed a stereo-vison based docking approach for underwater battery recharging to enable the AUV to operate for extended periods without returning surface vehicle for recharging. Since underwater battery recharging units are supposed to be installed in deep sea, the deep-sea docking experiments cannot avoid turbidity and low light environment. In this study, the proposed system with a newly designed an active 3D marker have been developed to improve the performance of the proposed system especially in turbid water. We conducted experiments to verify the robustness of the proposed docking approach in a simulated pool where lighting changes from day to night and the water is turbid. The experimental results have confirmed the robustness of the proposed docking system against turbidity and illumination variation.



January 18 (Thursday), 10:45–11:30

Room E

GS20 Swarm Intelligence

Chair: Takaya Arita (Nagoya University, Japan)

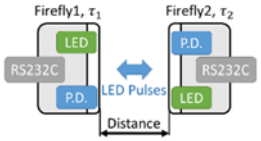
GS20-1 Route planning for multiple surveillance autonomous drones by using a discrete firefly algorithm and a Bayesian optimization method

Jordan Henrio, Theo Deligne, Tomoharu Nakashima
(Osaka Prefecture University, Japan)

This research focuses on the planning of routes for autonomous drones used for the surveillance of a given area. Routes consist of permutations of checkpoints selected by a human supervisor. The permutations are evaluated by a cost function that models the uncertainty of the monitored area's situation, according to the elapsed time since the last visit of the different checkpoints. This paper suggests to address the problem of permutation optimization by employing a discrete version of the firefly algorithm. It presents three exploration strategies: swapping random pairs of elements, shuffling a random subset of elements, and moving toward a noisy firefly. In addition, it also suggests to use a Bayesian optimization technique for tuning the firefly algorithm hyper-parameters, instead of commonly used grid-search and random search techniques.

GS20-2 Automatic threshold control for visible light underwater communication device using nonlinear synchronization

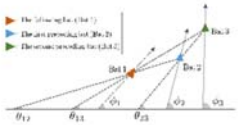
Taichi Ito, Junichiro Tahara, Masakazu Koike, Feifei Zhang
(Tokyo University of Marine Science and Technology, Japan)



This paper describes development of visible light communication devices for underwater swarms using a nonlinear synchronization. We study underwater swarm to apply to marine resource exploration. This has important and difficult problem. There is the change in electronic circuit characteristics because of high water pressure. We considered nonlinear synchronizing systems as effective because they can be synchronized even if system time constants differ. Nonlinear synchronization is a phenomenon that is often found in fireflies. We developed visible light communication devices based on the firefly concept. In this paper, we considered a method for extending the communicable distance. We implemented ATC (Automatic Threshold Control) for automatically setting a threshold to judge a light reception. The ATC is very effective. The communicate distance is maximum 600 mm. Moreover, the communication speed was 5.6 bps in the previous paper, however, we improved it up to 100 bps in both air and underwater.

GS20-3 Mathematical Modeling and its Application of Collective Behavior in Echolocating Bats

Ryo Hirata, Ikkyu Aihara, Tohru Kawabe
(University of Tsukuba, Japan)



In this study, we focus on bats having the superb ability of motion control and echolocation. Bats can form a flock and fly even in a narrow space such as a cave. We first propose a mathematical model that can explain the formation of a flock, and analyze the property of the model on the basis of numerical simulations. The simulations demonstrate that approaching the preceding individuals while slightly shifting own flight direction from the flight direction of the preceding individuals is profitable for the prompt formation of a flock. Moreover, we discuss the effectiveness of the proposed model as a formation control of electronic connected vehicles.

January 18 (Thursday), 14:30–16:00

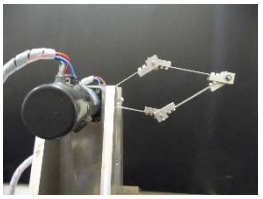
Room A

OS11 Robot control and AR/VR

Chair: Masahiro Yokomichi (University of Miyazaki, Japan)
Co-Chair: Nobuya Takahashi (University of Miyazaki, Japan)

OS11-1 A study on obstacle avoidance trajectory of manipulator with flexible element

Asaji SATO[1], Osamu SATO[2], Toshiki YAGI[2], Nobuya TAKAHASHI[2], Masahiro YOKOMICHI[2]
([1]National Institute of Technology, Miyakonojo College, Japan)
([2]University of Miyazaki, Japan)



For the rapid motion and the saving energy of transport by the manipulator, it requires a study for lighter mechanisms such as flexible link. And, trajectory planning of manipulator is necessary when the work space is limited. In this report, flexible links connected to the motor are modeled with rigid body connected by three springs. And, the equations of motion of manipulator are derived in consideration of the deflection of flexible elements and the characteristics of driving source. For the case to transport the object from the initial position to the desired position by the manipulator in a work space where an obstacle is present, the energy-saving trajectory influenced by vibration is calculated by the iterative dynamic programming method, and the effectiveness of the control method is evaluated by the numerical simulation. Furthermore, the effectiveness of the numerical simulation is confirmed by the experiment of flexible links which are driven by two motors with energy-saving trajectory.

OS11-2 Discrete-time Robust Controller and Observer for a Ball and Beam System

Nobuya Takahashi, Shosei Yayama, Osamu Sato, Masahiro Yokomichi
(University of Miyazaki, Japan)

This paper deals with a digital controller and observer design problem for the ball and beam system which is extended version of the previous investigated result. The controller is an extension of robust integral tracking controller. In the discrete-time system, it cannot perform integration and differentiation operation, so we introduce a difference system to design controller for the distance subsystem between reference and output. The observer is designed by using dual system LQ design method. The observer gain is able to obtain as the result of robust control design problem of dual system. Each design problem is solved by the guaranteed cost control method. Through the numerical result, we validity and effectiveness of our proposed method.

OS11-3 Development of Pseudo Haptic Feedback in VR Environment

Isamu Miyahara, Masahiro Yokomichi, Osamu Sato, Nobuya Takahashi
(University of Miyazaki, Japan)

In this paper, we propose a system that improves interaction by adding Pseudo Haptic effects to noncontact devices using motion sensors. In the system, a “virtual hand” is displayed on the screen which tracks the movement of the real hand. Its movement is affected by the shape and the mass of the virtual object, by giving a force to descend at a constant speed. It is a system that makes parts of virtual hands composed of virtual objects that perform physical calculations to the actual hand coordinates. After having implemented the system by a third party, it is shown that almost subjects are affecting the effect of Pseudo Haptics and it takes time to learn operability.

January 18 (Thursday), 14:30–16:00

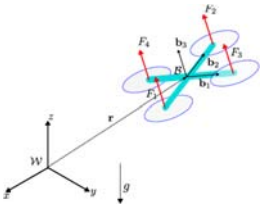
OS11-4 Design of a Gliding Drone with Flapping Wings

Yasunobu Hitaka, Hideo Yamada
(National Institute of Technology, Kitakyushu College, Japan)

In general, UAV (Unmanned aerial vehicle) is categorized into 2 types. The one is multirotor type and the other is fixed wing type. Recently, the flapping wing type like flying insects or birds have been researched and developed since it has new possibilities other two types cannot have. In this paper, we propose a new type of flapping drone which mainly flights by gliding and generates auxiliary thrust by flapping the wings like birds. The difference of previous bird robots is it is designed based on the design of RC glider in order to obtain good gliding performance. The design concept, avionics and fundamental mechanical design of our drone are denoted. Also, simulation results of gliding flight of designed drone are denoted.

OS11-5 Controller design for quadrotor based on I/O linearization

Masahiro Yokomichi, Yuta Yamashita, Nobuya Takahashi, Osamu Sato
(University of Miyazaki, Japan)



The purpose of this paper is to develop a controller for the position tracking problem with global stability based on the I/O linearization. It is known that the dynamics of quadrotor can be I/O linearized by means of dynamic feedback when the position is used as outputs. However, the controller and the internal dynamics has singularity due to the attitude parametrization with Euler angle. In this paper, less singular control law for I/O linearization is proposed. This controller uses the rotation matrix directly. In addition, we propose two approaches to cope with the singularity for the internal state. The former is to consider an angular velocity as output and the latter is to use the hybrid controller. The effectiveness of the proposed approach is evaluated by numerical simulations for position tracking problems.

OS11-6 Automated cover-uncover test system using active LCD shutter glasses

Noriyuki Uchida[1,2], Kayoko Takatuka[2], Kouki Hinokuma[2], Konomi Hirata[2],
Hisaaki Yamaba[2], Naonobu Okazaki[2]
([1]Kyushu University of Health and Welfare, Japan)
([2]University of Miyazaki, Japan)

The diagnosis of ocular malalignment is difficult and need examinations from ophthalmologists and orthoptists which are chronically insufficient. Part of the process of eye position check is systemized. With this check system, not only the symptom but also the angle and the extent of strabismus is detected. However, this method only useful for detecting one kind of strabismus which is divergent strabismus. The purpose of this study is to develop a simplified check system to screen at least the presence of strabismus apart from the type of strabismus or amount of ocular deviation. Digitalization of the check process was conducted. Specifically, the digitalization of element technology, “Cover-Uncover function “, was conducted necessary for the automation of the typical “Cover Test” for eye position check.

January 18 (Thursday), 14:30–15:45

Room B

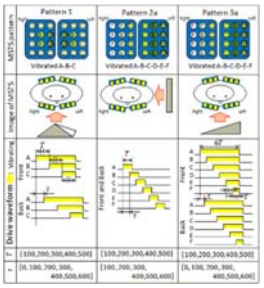
OS17 System Sensing and Its Application 1

Chair: Masafumi Uchida (The University of Electro-Communications, Japan)
Co-Chair: Kosuke Oiwa (Aoyama Gakuin University, Japan)

OS17-1 Time series Analysis of Body Sway Caused by Several Matrix-shaped Tactile Stimuli on Body Trunk

Masaki Terada, Masafumi Uchida
(The University of Electro-Communications, Japan)

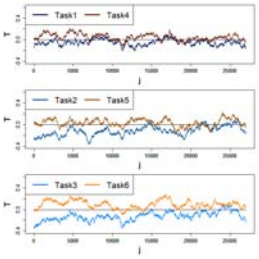
Postural control is an essential function of the human body that uses several senses and information from the body as input, processes the input and then provides output to the muscles for control. In this study, we examine a method wherein several matrix-shaped tactile stimuli (MSTS) located on the skin of the trunk are used to away subjects' bodies. To clarify the relationship between body sway and the MSTS, the subjects were tracked using a high-speed camera, a stabilometer, and two acceleration sensors. Owing to the nature of using human subjects, the resulting data had high variance; therefore, each trial data set exhibits different features. The effects of each MSTS on body sway and the dynamics of body sway are discussed and evaluated here. Additionally, we propose a single trial analysis method based on the clustering based Gaussian mixture model and smoothing filtering.



OS17-2 Gait Analysis Based on Transfer Entropy Method for Gait Stabilization

Kenkou Komaki[1], Hiroshi Kamoshita[2], Masafumi Uchida[1]
([1]The University of Electro-Communications, Japan)
([2]Kamoshita Ryouhou-jyo, Japan)

Gait stability affects quality of life. As such, evaluation of gait stability allows for an assessment of daily risk. In this study, a high-speed camera, acceleration sensors, and an electromyogram were used to measure the impact of added weight on gait stability. The transfer entropy method was used in the evaluation of stability based on the cooperative movement of the measurement points. The temporal variation of gait stability was also evaluated by analyzing data while shifting the search window. The analysis method showed changed in gait stability caused by the addition of weight.



OS17-3 A Contactless Blood Pressure Sensing Using Facial Thermal and Visible Images

Kosuke Oiwa, Shizuka Bando, Akio Nozawa
(Aoyama Gakuin University, Japan)

Hypertension is one of the leading risk factors for cerebrovascular, cardiovascular and chronic kidney diseases. Measurement and monitoring blood pressure any time is important to decrease or prevent pathogenesis of diseases. Measurement blood pressure contactlessly using small devices such as smartphone can enable us to monitor blood pressure any time. The aim of this study is a contactless sensing of vital signs such as blood pressure. We previously reported that the amplitude and time differences of facial photoplethysmogram (PPG) components extracted from facial color variation in facial visible images can be used to estimate blood pressure. Not only facial visible images, but also facial thermal images can get contactless and have been used as the indices of biological states. In this study, the reproducibility for estimation of blood pressure using facial visible images was verified and the accuracy for estimating blood pressure using facial visible and thermal images was evaluated.

January 18 (Thursday), 14:30–15:45

OS17-4 Classification of hemodynamic response to verbal task: effect of task difficulty and task complexity

Kent Nagumo[1], Kosuke Oiwa[1], Akio Nozawa[1], Tatsuya Iwaki[2], Tomoharu Ishikawa[3]
([1]Aoyama Gakuin University, Japan)
([2]Hiroshima International University, Japan)
([3]Utsunomiya University, Japan)

Measurement of hemodynamic response can be done objectively and in real time. Research on the classification of stress coping by evaluating cardiovascular response during stress coping has been conducted. On the other hand, these classifications of hemodynamics are evaluations of passively loaded mental stress tasks. Little is known that relationships between active attitudes towards tasks and hemodynamic responses. Therefore, there is some possibility of clarifying these relationships by continuously measuring hemodynamic response. In this study, hemodynamic response during the verbal tasks with changing task difficulty and complexity was measured and evaluated. The authors attempted to classify of hemodynamic response to the verbal task and clarify the relationship between active attitudes towards tasks and its response.

OS17-5 Extraction of Brain Wave Features for Cyclist Based on DAE

Taiga Mori[1], Shizuki Kachi[1], Akio Nozawa[2], Tota Mizuno[3], Shizuka Bando[2], Hirotoshi Asano[1]
([1]Kagawa University, Japan)
([2]Aoyama Gakuin University, Japan)
([3]The University of Electro-Communications, Japan)

The purpose of this research is to examine the effect of bicycle driving on brain activity. We conducted experiments on bicycle running with two types of riding posture (upright posture, forward leaning posture) will be conducted and the effect of each posture on brain activity will be examined. In addition, feature extraction was performed from brain wave measurement data by using Denoising Autoencoder, and the relevance to the psychological state of the subject was investigated.

January 18 (Thursday), 14:30–15:30

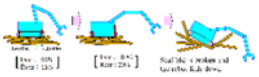
Room D

OS13 Robotics with Intelligence and/or Informatics 2

Chair: Mamoru Minami (Okayama University, Japan)
Co-Chair: Tetsuya Kinugasa (Okayama University of Science, Japan)

OS13-1 Relationships between motions of mounted redundant manipulators and reactions for rescue robots on rubbles

Masatoshi Hatano, Youhei Tsurumi
(Nihon University, Japan)



The purpose of this research is a proposal of a control method for a rescue robot with a mounted redundant manipulator in order to not break down rubbles where robots step on during working. When rubble withdrawal type rescue robots work in rescue fields, the robots often work on the scattered and unstable stacked rubbles. Therefore, there are possibilities that the motions of the rescue robots destroy the stacked rubbles, such as feet of the robots, and then the robots fell down. Against such problems, we aim to control balances of reactions utilizing redundancies of the mounted manipulator. In this paper, we performed simulations to discuss relationships between changes of reactions and changes motions of the redundant manipulator as a basic study. Then, possibilities for control of balances of reactions with control of a redundancy of the rescue robot will be shown.

January 18 (Thursday), 14:30–15:30

OS13-2 Wiping the mouth by using the robot arm with information of RGB-D sensor

Takeshi Ikeda[1], Tetsuhiro Makino[2], Kohei Ooba[1], Yoshiki Hirao[1], Fusaomi Nagata[1]
([1]Tokyo University of Science, Yamaguchi, Japan)
([2]Tokyo University of Science, Japan)

In recent years it has become difficult to support each person due to the lack of manpower in the field of welfare. It can be expected support by robots. The support robots are proposed that carried some food to the mouth in the researches on the support robots and mechanisms. However, we thought that task of eating support includes not only the carrying the food, but also cutting the food to eat easy, the mouth exercises before eating and wiping the stains around the mouth after meal. In this report, we propose the help with eating before and after meal supporting by robot system. We aimed to promote swallowing exercises before eating foods. It relaxes the muscles of the face and neck, then person can swallow food easy. And we propose the wiping the mouth by robot system after eating.

OS13-3 Verification of Illumination Tolerance for Human Recognition Mobile Robot based on Visual Servoing

Zeyi Zhang, Xiang Li, Mamoru Minami, Takayuki Matsuno
(Okayama University, Japan)

We propose a real-time human recognition and tracking system for AGV based on visual servoing. Using dual-eyes camera, the proposed system can distinguish human from background by color, estimate relative position and control AGV to achieve human tracking in real-time. We employ Genetic Algorithm (GA) and a RGB image termed here as raw-image to execute recognition process by a model-based matching method. As the main contribution for this paper, we have developed visual servoing using adaptive system for various natural light conditions including backlight based on HSV model. Experiment using a mobile robot with the proposed system were condected in a complex light environment. The experimental results confirmed that the proposed system is able to provide high homing accuracy and robustness against disturbances that the influence from not only the captured camera images under different lighting conditions but also the movement of the robot.

OS13-4 Force-sensorless shape-grinding for arbitrary curved surface object

Atsushi Sato, Zeyi Zhang, Takuro Izumi, Mamoru Minami
(Okayama University, Japan)

This research aims to achieve a new grinding robot system that can grind an object into desired shape with force-sensorless control. In order to grind the target object into desired shape with sufficient accuracy, the hand of the robot arm has to generate desired constrained force immediately after the grindstone being contacted with the metal object to be ground. Based on the algebraic equation, we have proposed Constraint-Combined Force Controller, which has the ability to achieve the force control without time delay. In this paper, we propose a method for grinding arbitrary carved surface object without force-sensor, which is composed of a two-dimensional grinding robot and an articulated robot that handles an object to be ground in front of the grinding robot. Three-dimensional grinding is performed by posing the object by an articulated robot and repeating two-dimensional grinding by our 2-link SCARA robot.

January 18 (Thursday), 14:30–15:15

Room E

GS7 Control techniques

Chair: Yuichiro Taira (Sojo University, Japan)

GS7-1 Characteristic analysis of Fuel Cell for Electric ship

Hiroyuki Sakurai[1], Tsuyoshi Oode[1], Etsuro Shimizu[1], Naoya Sugiyama[1], Tsuyoshi Yamakuchi[2]
([1]Tokyo University of Marine Science and Technology, Japan)
([2]NREG TOSHIBA BUILDING CO.,LTD., Japan)

In recent years, hydrogen fuel cells have been paid attention as one of the new energy options. Currently the most popular fuel cell technology is a cogeneration system using a stationary fuel cell called Enefarm. On the other hand, sales of mass production type Fuel Cell vehicles (FCVs) has begun in 2014. The fuel cell bus service in Tokyo has been started in. In this research, a hybrid battery propulsion ship "Raicho N" equipped with a lithium ion battery and a diesel generator is used as an experiment ship. A fuel cell is installed for implementation and the difference in characteristics by generating electricity in the anchoring and navigation in river is investigated. In addition, the optimum configuration of fuel cell and the battery as a buffer is discussed.

GS7-2 Motion control of multi legged walking robot for tideland research using the nonlinear synchronization phenomena

Kei Nakamura, Junichiro Tahara, Masakazu Koike, Feifei Zhang, Mikihiro Saito
(Tokyo University of Marine Science and Technology, Japan)

In this study, we aim at the development of motion control system for the multi-legged walking robot. This system can be done movement suitable for the change of environments like an animal in the nature. So far, we considered about control method created a walking pattern by GA (Genetic Algorithm). But, this method requires a lot of times about making pattern suitable for walking. Also, this method is the open loop control system. When the environment changes, walking pattern have required redesign. Thus, we consider about the control method using nonlinear synchronization. This control method makes only the stable walking pattern, and try to shorten the time using it. Firstly, in the open-loop control system, we confirmed that can make the stable walking method using nonlinear synchronization. Secondly, in the feedback control system, we examined the system as a suitable for the change of environment.

GS7-4 Improved stability criteria for discrete-time neural networks with time-varying delays via a modified first-order polynomials-based summation inequality

Seok Young Lee, JunMin Park, PooGyeon Park
(Pohang University of Science and Technology, Korea)

In recent years, neural networks have attracted considerable attention due to their successful applications in many fields. When utilizing neural networks, time delay is a one of main concerns since it causes unpredictable dynamic behaviors of the systems. Therefore, this paper deals with stability analysis problems of discrete-time neural networks. More specifically, this paper aims at deriving improved stability criteria for discrete-time neural networks with time-varying delays. For this purpose, a modified first-order orthogonal polynomials-based summation inequality and general activation function conditions are proposed to reduce the conservatism of the stability criteria. Further, by designing an arbitrary vector of the summation inequality, a feasible region of stability criteria is enlarged. Two numerical examples are included to show the effectiveness of the proposed approaches.

January 19 (Friday), 09:30–10:45

Room A

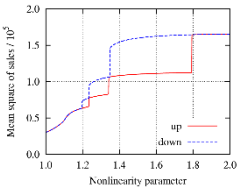
OS15 Social Simulation

Chair: Itsuki Noda (National Institute of Advanced Industrial Science and Technology, Japan)
Co-Chair: Nobuyasu Ito (The University of Tokyo, Japan)

OS15-1 Modeling and simulation of Japanese inter-firm network

Jun'ichi Ozaki[1], Koutarou Tamura[1], Hideki Takayasu[1,2], Misako Takayasu[1]
([1]Tokyo Institute of Technology, Japan)
([2]Sony Computer Science Laboratories, Inc., Japan)

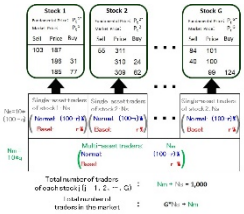
We simulate the real-size Japanese inter-firm trading network composed of approximately one million firms. The simulator calculates the following quantities of the inter-firm trading network: the network structure, the money transport between the firms, and the dynamical property of the network. It is applicable to enough large system consisting of one or two million nodes, to simulate the whole inter-firm trading network in Japan. The steady state of the network is calculated, on which the money flow between the firms is estimated. The sales distribution as well as the growth rate distribution is calculated. We also investigate the significant changes of the money transport property on the network with large hysteresis.



OS15-2 Destabilization effect of VaR-based risk management on a multiple-asset market -An artificial market approach-

Hiroto Yonenoh, Kiyoshi Izumi
(The University of Tokyo, Japan)

In this study, using agents optimally readjusting their portfolios, we explored the effects of VaR-based risk management on both a single and a multi-asset double-auction markets. Computer simulation produced the following results: (1) Increasing the number of market participants applying risk management by VaR caused instability in the multi-asset continuous double-auction market. (2) Increasing portfolio trading reduced the instability effect of the risk management by VaR.



OS15-3 Multi-Agent Simulations for Finding Reasonable Taxi Hiling Strategies

Hiromitsu Hattori[1], Hiroaki Kingetsu[2]
([1]Ritsumeikan University, Japan)
([2]Kyoto University, Japan)

Multi-Agent Simulation can model complex systems and compute social phenomena within the system, and traffic is one of the most popular subjects. Urban traffic flows consist of many vehicles with different roles/types of vehicles, each of which has its own reason for movement, such as route buses, taxis, trucks, general vehicles, and so on. In this paper, we analyze and model vehicles' behaviors using probe-car data. We construct a taxi agent model that can represents individual traffic behaviors and apply the model to urban traffic simulations where general vehicles, bus and taxis co-exist in the realistic road network of the city of Kyoto, Japan. We replicate how to construct a taxi's behavior model that represents business strategies and stochastic selection of business area based on probe-car data. Then, we realize traffic flows in Kyoto with obtained taxi agents, bus agents, and general vehicle agents.

January 19 (Friday), 09:30–10:45

OS15-4 Analysis of Trade-off in Evacuation Plan using Evolutionarily Exhaustive Simulation

Hiroyasu Matsushima, Itsuki Noda
(National Institute of Advanced Industrial Science and Technology, Japan)

We report the analysis of trade-off structure in evacuation plan from disaster based on the results of exhaustive simulation controlled by evolutionary methods. Design for disaster response is not a simple optimization. For example, in the evaluation scenario, while the effectiveness of the plan (total evacuation time) is the first priority, we also need to pay attention the feasibility and executability of the plan in real situations. Generally, such multi-objective planning has a trade-off structure. We apply the combination of exhaustive simulation and evolutionary method to illustrate the trade-off structure. We investigate the structure and try to figure out the features of evaluation plans on real maps.

OS15-5 Large-scale social simulation framework "X10-based Agent Simulation on Distributed Infrastructure (XASDI)" and applications

Hideyuki Mizuta, Takashi Imamichi
(IBM Research AI, Japan)

We have developed a large-scale distributed simulation framework "X10-based Agent Simulation on Distributed Infrastructure (XASDI)" and its applications with the support of JST CREST. XASDI is available as open-source software at GitHub with tutorial, API documents and sample programs (https://github.com/x10-lang/xasdi). We also provide a setting file for Docker for users to construct XASDI environment and run demo applications easily. XASDI is large-scale distributed agent-based social simulation framework that can manage enormous number of agents. X10 language enables highly parallel and distributed execution for cluster environment or supercomputer. On the other hand, it provides easy-to-use API with Java that is familiar to application programmer of social simulations. By utilizing XASDI framework, we can develop various social simulation applications such as traffic, pedestrian, and economic simulation written in Java. The first application of XASDI is the large-scale traffic simulator for metropolitan or whole area of Japan. As the second application of XASDI. we also introduce an integrated simulation of walking and purchasing behavior in a shopping mall or a city area with various buildings and roads that are extracted from OpenStreetMap.

January 19 (Friday), 09:30–10:30

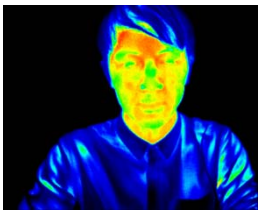
Room C

OS18 System Sensing and Its Applications 2

Chair: Tota Mizuno (The University of Electro-Communication, Japan)

OS18-1 Investigation on Estimation of Autonomic Nerve Activity of VDT Workers Using Characteristics of Facial Skin Temperature Distribution

Tomoyuki Murata[1], Kota Akehi[1], Shogo Matsuno[2], Kazuyuki Mito[1], Marzieh Aliabadi Farahani[1], Naoaki Itakura[1], Tota Mizuno[1]
([1]The University of Electro-Communication, Japan)
([2]Toyohashi University of Technology, Japan)



In this research, we aim at the quantitative evaluation of human sensibility information and estimated the autonomic nervous activity by using the facial skin temperature. In previous research, according to analyzation of entire face, it is possible to evaluate mental workload (MWL) with high accuracy by modifying the nose temperature. Therefore, depends on MWL, through the modification of skin temperature. It's not only the nose temperature but also mouth temperature will change. However, it has been clarified in previous studies that the edge portion of the face, where there is no angle between the thermography and the object to be photographed, has been decreased in consequence of reflections estimation accuracy was also increased. Further, there is a possible of change in analysis result by hair, eyeglasses, etc., if the entire face is chosen. In this research, we aim to focus on temperature distribution of the face and find the facial area.

OS18-2 A method of character input in an operating environment with low degree of freedom

Shogo Matsuno[1], Susumu Chida[2], Naoaki Itakura[2], Tota Mizuno[2], Kazuyuki Mito[2]
([1]Toyohashi University of Technology, Japan)
([2]The University of Electro-Communications, Japan)

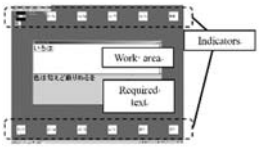
In recent times, smart devices equipped with small touch panels have become very popular. Many such smart devices use a software keyboard for character input. Unfortunately, software keyboards have a limitation: the number of buttons and the input degrees of freedom remain the same, because a button and an input value correspond one-to-one. Thus, if we reduce the screen size while the button size remains the same, the number of buttons must decrease. In this study, we investigate a new character input method suitable for small screens. Additionally, we experimentally evaluate a character input user interface deployed on a smart device, based on the proposed method. The proposed method shows robust input performance on a small screen compared to previous software methods. Thus, the proposed method is better suited to small screens than previous methods were.

January 19 (Friday), 09:30–10:30

OS18-3 Improvement of text input system using two types of voluntary blinks and eye-gaze information

Hironobu Sato[1], Kiyohiko Abe[2], Shogo Matsuno[3], Minoru Ohyama[2]
([1]Kanto Gakuin University, Japan)
([2]Tokyo Denki University, Japan)
([3]Toyohashi University of Technology, Japan)

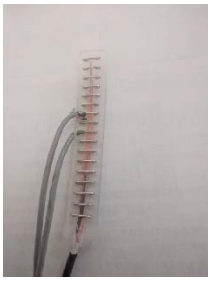
Input interfaces using voluntary blink and eye-gaze information have been proposed. A main purpose of these systems is communication aid for the severely disabled. An input system employed eye blinks as command inputs needs to classify voluntary (conscious) blinks. We previously developed an eye-gaze input system for Japanese text creation. Our previous system employed an indicator selection method as command inputs. This previous system was able to classify two types of voluntary blinks. These two types of voluntary blinks work as functions of an indicator selection and an error correction, respectively. In this paper, we propose a new input system that employs a selection method based on a novel indicator estimation algorithm. We conducted an experiment to evaluate the performance of Japanese text input using our new input system. This paper reports that using our new input system improves the speed of text input.



OS18-4 Analysis of end-plate on conducting wave parameters by using multi-channel surface EMG

Marzieh Aliabadi Farahani, Hiroki Yamada, Kota Akehi, Kazuyuki Mito,
Tota Mizuno, Naoaki Itakura
(The University of Electro-Communications, Japan)

Skeletal muscle is made up of thousands of muscle fibers that run the length of the muscle. Each muscle fiber consists of many contractile units called myofibrils which run the length of each muscle fiber. Action potential of muscle fibers is related to the neuromuscular junction which is a chemical synapse formed by the contact between a motor neuron and a muscle fiber. It is called “end plate” and it spreads from both sides of tendons. Surface electromyogram (EMG) is used to measure the action potential. Normally, surface EMG is used as an interference wave of action potential that is generated by some of motor units in muscle. In this research, every conducting wave will be investigated by multi-channel surface EMG signal and be analyzed the feature of the forming process for conducting waves in order to evaluate the position of the end-plate.



January 19 (Friday), 09:30–10:30

Room D

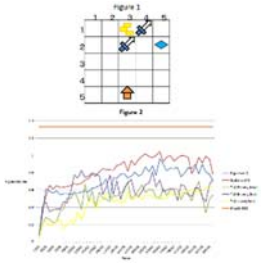
GS12 Learning

Chair: Takayasu Fuchida (Kagoshima University, Japan)

GS12-1 Multiobjective Reinforcement Learning Using Success Probabilities and Rewards

Naoto Horie[1], Tohgoroh Matsui[2], Koichi Moriyama[1], Atsuko Mutoh[1], Nobuhiro Inuzuka[1]
([1]Nagoya Institute of Technology, Japan)
([2]Chubu University, Japan)

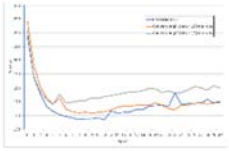
Reinforcement Learning (RL) is a learning method that learns actions based on trial and error. Recently, Safe Reinforcement Learning (SafeRL) and Multi-objective Reinforcement Learning (MORL) have been studied. The objective of conventional RL is to maximize the expected rewards; however, this may cause a fatal state because safety is not considered. Therefore, RL methods that consider safety during or after learning have been proposed. SafeRL is similar to MORL because it considers two objectives, i.e., maximizing expected rewards and satisfying safety constraints. However, to the best of our knowledge, no study has investigated the relationship between SafeRL and MORL to demonstrate that the SafeRL method can be applied to MORL tasks. As an example, we apply Expected Q-Learning to the Resource Gathering task, which is a standard task used in MORL test cases.



GS12-2 A Neural Language Model by Heterogeneous Recurrent Neural Networks

Masayuki Tsuji[1,2], Teijiro Isokawa[1], Takayuki Yumoto[1], Nobuyuki Matsui[1], Naotake Kamiura[1]
([1]University of Hyogo, Japan)
([2]Cadence Design Systems, Japan)

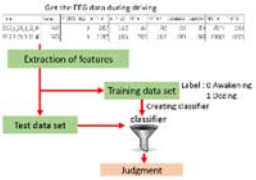
A neural network is proposed for constructing language models, which is motivated by complex-valued neural networks. The proposed network consists of two recurrent network of which structures are different to each other. Both networks accept words as their inputs, translate their distributed representation, and produces the probabilities of words to occur from their sequence of input words. Performances for the proposed network are investigated through constructions for language models, as compared with a single recurrent neural network.



GS12-3 A method of Doze Detection by Machine Learning Using EEG

Daichi Naito, Ryo Hatano, Hiroyuki Nishiyama
(Tokyo University of Science, Japan)

Death accident due to careless driving is a serious problem in recent years, according to Tokyo Metropolitan Police Department Transit Authority. Careless driving means that the driver is not concentrating on driving, and doze as one of the causes. In this study, We focus on a method to detect dozing driving. Until today, distinction between an awaking and a sleeping states have been detected with various ways such as electroencephalogram (EEG) and pulses. In particular, EEG is often used to distinguish stages of sleep, hence we aim to detect drowsy driving using EEG. Since it is important to discriminate the dozing of the driver automatically, we use machine learning methods as a result when we used KNN, the F value was 92.1%. We have shown availability of detecting drowsy driving by machine learning from EEG data.

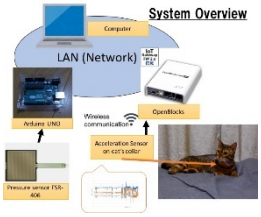


January 19 (Friday), 09:30–10:30

GS12-4 Cat health management system using support vector machine based on acceleration and pressure sensors

Rina Katsumata[1], Ryo Hatano[2], Hiroyuki Nishiyama[2]
([1]Ichikawa Gakuen Ichikawa High School, Japan)
([2]Tokyo University of Science, Japan)

In this study, we intend to devise a comprehensive new health management system that makes it possible to manage cats' health using data regarding their amounts of food and exercise. To achieve this goal, two variables must be measured. One is the amount of food, which is recorded using a pressure sensor attached to a cat bowl. The other is the amount of exercise, which is calculated using data from an acceleration sensor attached to a cat collar. We employ the machine learning method Support Vector Machine to identify the kinds of motion a cat has performed and calculate the amount of exercise using the data from the acceleration sensor. We defined eight categories of motion for the machine learning procedure. In the process of machine learning, we conducted 10-fold cross-validation to obtain the accuracy, which was found to be 83.67%.



January 19 (Friday), 09:30–10:15

Room E

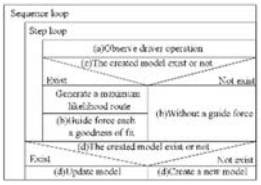
GS2 Artificial brain & Brain science

Chair: Hideo Araki (Osaka Institute of Technology, Japan)

GS2-1 A Proposal of Driving system for Creating Suitable driving model by using the Force interaction between the driver and the vehicle

Yuuki Masukawa[1], Hirokazu Mastui[1], Abdul Hamid Adom[2], Norihiko Kato[1]
([1]Mie University, Japan)
([2]Universiti Malaysia Perlis, Malaysia)

The proposed a driver system is so that driver feels more favorable in driving. The proposed system learns the driver's intentions through his/her steering operations and leads the driver to appropriate steering operations through guide forces. The proposed approach uses a method that creates appropriate models from driver's operating sequences and that indicates guide forces to the driver, according to the next operating sequence estimated by the model that is matched with the current operating sequence. Each model is represented by Hidden Markov Model (HMM), which is often used voice recognition. This can be referred to as human communication. The proposed system is ensured by other system for safety driving. A system on the hardware side that consists of small mobile, handle with guide force, and input velocity pedal were prepared. This research evaluates whether it is better to provide guide force to update the model system or not. The results show that the system was able to update model by using guide force. The system was tested using two operation methods, namely with and without guide force. The system with the guide force was able to function better as a driver`s assist system, and hence prove to be superior to that without guide force.

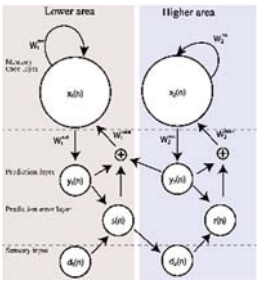


January 19 (Friday), 09:30–10:15

GS2-2 Hierarchical network model of auditory information processing using dynamical predictive coding

Kanata Ara[1], Yuichi Katori[1,2]
([1]Future University Hakodate, Japan)
([2]The University of Tokyo, Japan)

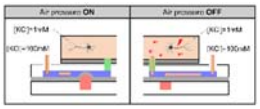
Auditory system in the brain plays crucial roles to establish efficient communication by natural languages or by music. The auditory system must conduct prediction and generation of highly structured and complex time-varying auditory signal. However, the detailed dynamical mechanism of the auditory information processing is still unknown. Here, we proposed a hierarchical network model with the concepts of the predictive coding and the reservoir computing. The predictive coding is based on the hierarchical structure of the cortical network, which predicts incoming stimuli of perceptual information. The reservoir computing is a framework for generating complex time course with less computational cost. We evaluate the pro-posed hierarchical network model with musical phrases. The model successfully generates the complex multi-dimensional time courses of the auditory signal. We also analyze the dependence of ability of the generation of the acoustic signal on various model parameters.



GS2-3 Biomimetic Microfluidic Neurons for Bio-Hybrid Experiments

Stéphany Mai Nishikawa[1], Soo Hyeon Kim[1], Zhongyue Luo[1], Takaaki Kirihara[1], Yoshiho Ikeuchi[1], Teruo Fujii[1], Timothée Levi[1,2]
([1]Institute of Industrial Science (IIS), The University of Tokyo, Japan)
([2]IMS Lab, University of Bordeaux, France)

Millions of people worldwide have incurable and debilitating conditions called neurodegenerative diseases that influence one's cognitive and/or motor functions. There is currently an increasing number of neuroprosthesis but they have power consumption and biocompatibility issues. To bring neuroprosthesis into realization and for future long-term replacement of damaged brain areas with artificial devices, understanding of neurophysiological behaviors and investigations on the interaction of neuronal cell assemblies is essential. To circumvent the limitations, in this article we propose a biomimetic artificial neuron to mimic and/or to replace the biological neurons. This biomimetic neuron is based on microfluidic technique with ionic exchange capable of performing bio hybrid experiments.



January 19 (Friday), 13:00–14:15

Room A

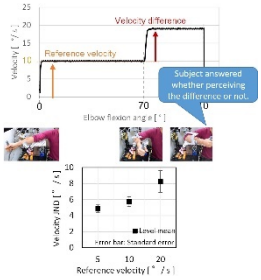
GS11 Human-machine interaction and collaboration

Chair: Minami Kaneko (Nihon University, Japan)

GS11-1 Velocity change perceptual characteristics in passive elbow flexion movement

Fumihiro Akatsuka, Yoshihiko Nomura, Tokuhiro Sugiura
(Mie University, Japan)

In recent years, haptic guidance by robot manipulators has been used in human motor learning. In receiving the guidance, humans perceive the movement via proprioceptors. Therefore, it is important to know the perceptual characteristics for the guidance design. In this study, a velocity-difference discrimination experiment was conducted in passive elbow flexion movements using a 1-DOF manipulator. Eight subjects performed acceleration movements, where velocities were accelerated from a constant velocity (reference velocity) to another constant velocity. The Just Noticeable Differences (JNDs) were evaluated for the three experimental condition factors: (1) reference velocities, (2) duration times during velocity change, (3) velocity-change angles. The results showed the followings: (1) the JNDs tended to increase as the reference velocity increased, (2) as the duration-time became shorter, the JNDs seemed to decrease, (3) the JNDs seemed to be influenced by the velocity-change angle.



GS11-2 Affective computing to help recognizing mistaken pedal-pressing during accidental braking

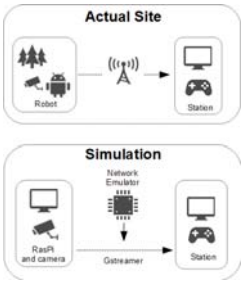
Rahadian Yusuf, Ivan Tanev, Katsunori Shimohara
(Doshisha University, Japan)

Affective computing has been used to improve computer usability and user interface, by considering user's emotion. One aspect of affective computing is emotion recognition. There have been many researches regarding emotion recognition, yet there is still room for exploration in applying affective computing into driver assistance system. On driving assistance, one aspect is about emergency braking. Several researches have been analyzing emergency braking and proposed approaches to detect them. A more focused but significant (especially for elderly and beginner driver) case is mistakenly pressing accelerator instead of brake pedal during emergency braking, which often lead to accidents. This paper investigates researches on affective computing, emergency braking, and mistaken pedal pressing, and proposing a possible approach for improving existing driving assistance system using affective computing. For preliminary experiment, driving simulator's brake pedal is manipulated to act as accelerator pedal during emergency braking, while observing driver's change of expression.

GS11-3 Quantitative Evaluation of Streaming Image Quality for The Robot Teleoperation

Ikumi Otani, Yuichi Yaguchi, Keita Nakamura, Keitaro Naruse
(University of Aizu, Japan)

In this paper, we define a novel measure of streaming video quality for remotely operated robots. Controlling robots remotely is crucial for disaster response, and many attempts have been made to create such systems. Wireless communication, which is used in remote-control systems for unmanned vehicles, change dynamically and the streaming quality also changes to the quality of the network; however, wireless conditions are not typically measured in conventional robot systems. We are developing a quality measure for remote control using video proprieties such as delay and degrading of image quality as Quality of Control (QoC). In this paper, we introduce this QoC measure using delay and degrading of image quality curves in simulation environments, and we discuss the implications for robot system design.



January 19 (Friday), 13:00–14:15

GS11-6 Development of a Video Chat System Superimposing a Pupil CG Synchronized with Utterance on the Partner's Pupil

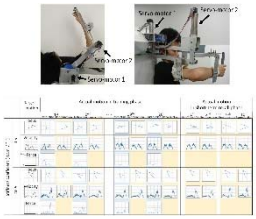
Ryosuke Maeda, Shoichi Egawa, Yoshihiro Sejima, Yoichiro Sato, Tomio Watanabe
(Okayama Prefectural University, Japan)

Pupil response plays an important role in expression of talker's affect. Focusing on the pupil response in human voice communication, we analyzed the pupil response in embodied interaction and demonstrated that the speaker's pupil was clearly dilated during burst-pause of utterance. In addition, it was confirmed that the pupil response is effective enhancing affective conveyance by using the developed system in which an interactive CG character generates the pupil response based on the burst-pause of utterance. In this study, we developed a video chat system which superimposes the partner's pupil CG on the partner's eye position in video chat image for enhancing affective conveyance.

GS11-7 An exoskeletal motion instruction with active/passive hybrid movement - Haptic-device force is applied to voluntarily-moving musculoskeletal system -

Fumihiro Akatsuka, Yoshihiko Nomura, Tokuhiro Sugiura, Takaaki Yasui
(Mie University, Japan)

Haptic devices have been studied as useful tools for motion instruction. In this paper, we take up the method in which the device instructs momentary human-reproduced movement-errors by giving force. A subject trains two-stroke hand motions on a horizontal plane. The subject learned the lengths, angles and velocities of the each stroke. The device-given force is calculated by multiplying a stiffness coefficient to the momentary hand position error. The experiment constituted of the training phase, the short-term recall phase after the training phase and the long-term recall phase on the next day. The experimental results showed that even under the low stiffness coefficient condition, the subject successfully performed the close motion to that under the ordinarily employed-high stiffness coefficient condition in the short-term recall phase. Meanwhile, under the high stiffness coefficient condition, the performance deteriorated in the long-term recall phase.



January 19 (Friday), 13:00–14:30

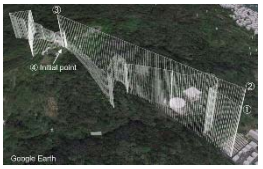
Room B

OS4 Biomimetic Machines and Robots

Chair: Keigo Watanabe (Okayama University, Japan)
Co-Chair: Fusaomi Nagata (Tokyo University of Science, Yamaguchi, Japan)

OS4-1 Remote Control iOS Application for a Quadrotor UAV

Zeming Lu[1], Fusaomi Nagata[1], Keigo Watanabe[2]
([1]Tokyo University of Science, Yamaguchi, Japan)
([2]Okayama University, Japan)



With the progress of electronics and information technologies, the development of civilian UAV (unmanned aerial vehicle) applications becomes possible. In addition, smartphones have rapidly gained popularity and become very important due to the simple operability and mobility. Hence, there is a need to have an easy and flexible way to control a UAV using such a smartphone. A remote control application was already developed for a quadrotor to enable an operator to remotely control it and monitor its surroundings using an iOS device. Basic handlers for obtaining compass information, controlling a gimbal, autopilot function for return were implemented. In this paper, following and rounding a moving object function while gazing it are first developed. Then, another function called the mission planning is additionally designed and implemented to allow the quadrotor to execute a self-flight function using GPS information. As a result, the iOS application enables the quadrotor to achieve complex tasks. The functionality of the developed software is evaluated through experiments using a quadrotor and an iOS device.

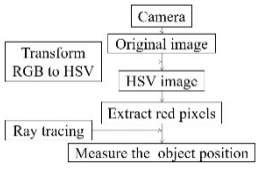
OS4-2 Design and Manufacture of a Multifunctional Aerial Robot with Tilted Coaxial Rotors

Xiongshi Xu, Keigo Watanabe, Isaku Nagai
(Okayama University, Japan)

The objective of this research aims at realizing an aerial robot having multifunctional flight modes. Although in the flight mode, the proposed aerial robot is fundamentally based on the locomotion of the VTOL vehicle with coaxial rotors as the thrust sources, it can move on the ground and run on the wall by using passive wheels. In this paper, we first describe the design and manufacture of an aerial robot, which can achieve multifunctional locomotion modes, by using tilted coaxial rotors. After designing and manufacturing a coaxial rotor, together with giving a fundamental experiment on the thrust check of such a rotor, some experiments on the ground running modes are conducted to demonstrate the effectiveness of the proposed robot.

OS4-3 A Method of Measuring a Distance to Underwater Obstacles by Image Processing with a Laser

Shingo Sugano, Keigo Watanabe, Isaku Nagai
(Okayama University, Japan)



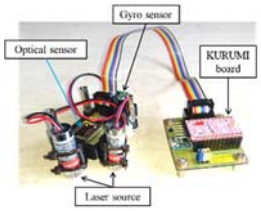
Recently, several researches are actively conducted on applying underwater robots to underwater activities such as maintenance of underwater structures, academic investigation, rescue, etc. This study focuses on AUVs (Autonomous Underwater Vehicles). In particular, it is aimed at constructing an obstacle avoidance system that can be installed in small AUVs. In this research, any obstacles are recognized by image processing using a camera and a laser module. In this paper, an approach based on using the ray tracing method is described for measuring the distance to an obstacle. Then, an optical cutting method is described to recognize the width of the obstacle. In addition, some experiments are conducted and reported to verify the usability of each method.

January 19 (Friday), 13:00–14:30

OS4-4 Speckle Odometer Robust to Specular Reflection for Estimating the Position of Mobile Robots

Takahiro Kawai, Isaku Nagai, Keigo Watanabe
(Okayama University, Japan)

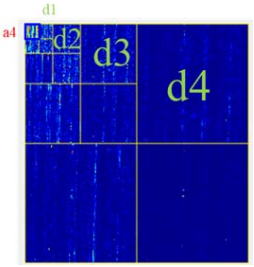
Position estimation is indispensable for a mobile robot, and many researches are actively studied.As a positioning method, a measuring device using a speckle odometer and a gyro sensor has been studied. The conventional device cannot detect motion on a floor with characteristics of specular reflection because the laser in the device vertically irradiates the floor surface. In this research, position estimation robust to the surface with specular reflection characteristics is achieved by changing the irradiation angle of the laser light. In this paper, the device component, measurement method, and position estimation method are described. In addition, experiments estimating amount of movement are reported for verifying the usefulness of the proposed method.



OS4-5 Characteristic extraction of machined surface used wavelet transformation

Koumei Muramatsu, Akimasa Otsuka, Mizuha Sugi, Fusaomi Nagata
(Tokyo University of Science, Yamaguchi, Japan)

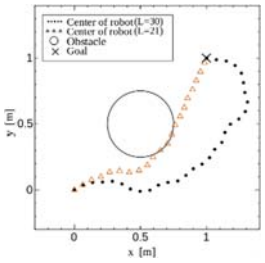
In development and design of machinery products, product performance is usually calculated on computers using CAE software. In the CAE calculation, product shape is modeled as set of geometric ideal forms, i.e. plane, cylinder and sphere. However, an actual product is different from those ideal forms because it has geometric deviations, waviness and surface roughness. Therefore, calculation error between CAE and actual product is caused by the product shape simplification. To reduce the calculation error, in this study, a generation method of pseudo plane using discrete wavelet transform is proposed. The proposed method is consisting of several processes. Firstly, in characteristic extraction process, wavelet transform is applied to extract tool patterns of machined surface in each scale level. Wavelet transform is often used in the fields of image and audio processing. Because the measurement data is usually discrete, discrete wavelet transform, which is called wavelet decomposition, is applied to the data. In this paper, several mother wavelets, Haar, Daubechies, Coiflet, and Symlet etc. are used for wavelet decomposition. Then, normality test are conducted for wavelet coefficients obtained after the decomposition to find existence of surface characteristics.



OS4-6 Path planning by genetic algorithm including chromosome length search

Masataka Tanizaki, Kiyotaka Izumi, Takeshi Tsujimura
(Saga University, Japan)

In this paper, we proposed an extended genetic algorithm to be able to optimize the length of chromosome. The proposed approach had double loop structure which were to optimize chromosome and its length. We applied the proposed approach to the optimal path planning of a mobile robot which moved on a plane with obstacle. The effectiveness of the proposed approach was discussed by simulation results of a path planning. Finally, we obtained the optimal path that has the minimum length.



January 19 (Friday), 13:00–14:00

Room C

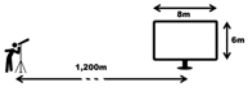
OS6 Intuitive Human-System Interaction (Part I)

Chair: Masao Yokota (Fukuoka Institute of Technology, Japan)
Co-Chair: Naoto Iwahashi (Okayama Prefectural University, Japan)

OS6-1 Emotional Evaluation for Images Displayed with Different Type of Screens in Virtual Reality Headset

Masahiro Yamaguchi[1], Masayo Matsumura[2], Hikari Shimada[3], Kenji Araki[1]
([1]Hokkaido University, Japan)
([2]BiPSEE Inc., Japan)
([3]Iryouhoujin Koukeikai, Japan)

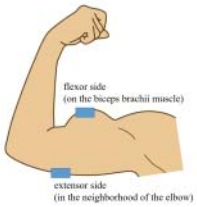
We carried out an experiment to examine emotional effect with images displayed in different type of virtual screen in VR-HMDs, and evaluate the emotional response. We manipulate FOV (Field of view) of a virtual camera in VR to change the view of contents. Decreasing FOV makes view of angle narrow, therefore the view in VR looks similar to the one using telephoto lens, in which environment the view greatly moves with even small camera movement. With smaller value of FOV for a virtual camera, the view in VR is more sensitive to HMD movement and requires subjects to keep concentrating not to move their heads to watch target images properly. Stronger emotional responses were observed with smaller value of FOV in the experiment. The result indicates the possibility of controlling effectiveness of contents with displaying software in VR. This result is expected to improve medical usage of VR contents.



OS6-2 Experimental investigation of motion sensor placement on human skin surface appropriate for evaluating wearing mobility of wearable elbow motion support mechanisms

Tetsuya Morizono, Kousuke Fukutomi, Naoki Koyanagi, Hiroyuki Matsubara
(Fukuoka Institute of Technology, Japan)

If we consider evaluating the mobility of a wearable elbow motion support mechanism based on measurement of relative motion between the mechanism and a human upper limb wearing the mechanism, location of motion sensor placement on the human upper arm is considered to be a critical issue, because deformation of the biceps brachii muscle inducing elbow motion may move a sensor on skin surface near the muscle and disturb accurate measurement of the relative motion by the sensors. This paper reports experimental investigation on motion sensor placement on a human upper arm which gives less sensor movement against elbow motion. Comparison of evaluations between two sensor placements examined by measurement demonstrates that sensor placement on the extensor side in the neighborhood of human elbow joint is more advantageous to obtaining reduced movement of the motion sensor.



January 19 (Friday), 13:00–14:00

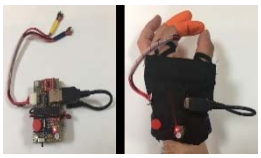
OS6-3 On Extension of Conversation Management System by Employing Visual Information

Thanoo Kungwanchai[1], Rojanee Khummongkol[1], Masao Yokota[2]
([1]University of Phayao, Thailand)
([2]Fukuoka Institute of Technology, Japan)

Most of human societies nowadays always relate to computer sciences and technologies. For example, computer-aided location measurement utilities like GPS are widely used among travelers all over the world. This is also the case for rapid development of robotics. It would not come true without remarkable advance in computer hardware and software. However, technologies for human-robot communication have not yet been well established enough for everyday use because of stagnation of Natural Language Understanding in the field of Artificial Intelligence. Our previous works focused on intuitive Conversation Management System (CMS) that was designed to understand human words by accepting many types of expressions in natural language. The system interprets input texts into logical expressions in Mental-image Description Language (Lmd): a formal language that is presented by M. Yokota in 2005. Spatiotemporal expressions in Lmd correspond with graphically interpretable loci in attribute spaces modeled as mental images. CMS is controlled by an imaginary robot agent named “Anna” and User is to take the role of her master “Taro”. This paper is about CMS extended by providing Anna with two new functions. The first function is for seeing her environment to find her walking paths to target objects, and the second one is for obstacle avoiding.

OS6-4 A study on interface for screen operation to reduce tiredness at manufacturing training using ICT in elementary and secondary education

Hiroshi Hazama[1], Yasuo Ebara[2], Tsukasa Ogasawara[3]
([1]Seisho High School, Japan)
([2]Kyoto University, Japan)
([3]Nara Institute of Science and Technology, Japan)



In the manufacturing training using ICT of elementary and secondary education, it is difficult to operate the screen of the computer while working with both hands in the manufacturing training by using the conventional interface device which operates while holding it in one hand. In response to these problems, we have designed and implemented a prototype of the interface for screen operation which is possible to wear on the wrist in our existing study. However, we have found out the problem which accompanied by a feeling of physical and mental weariness by becoming conscious of the existing interface. In this study, to solve these problems, we designed and implemented new interface for screen operation that wears one hand, and reduce the tiredness despite the use for a long time. In this paper, we presented at the outline of the interface.

January 19 (Friday), 13:00–14:30

Room D

OS1 Advanced intelligent system for education

Chair: Eiji Nunohiro (Tokyo University of Information Sciences, Japan)
Co-Chair: Yorinori Kishimoto (Tokyo University of Information Sciences, Japan)

OS1-1 Expansion of Automatic Practice-Problem Creating Function in PPL system

Ryosuke Kamikura, Yorinori Kishimoto, Takashi Yamaguchi, Masanori Ohshiro,
Shigeo Tsukuta, Eiji Nunohiro
(Tokyo University of Information Sciences, Japan)

In this study, we proposed a problem-based learning method of mastering the capability to solve a problem in programming education, and developed the Problem-based Programming Learning system, i.e., “PPL system”. In 2016, we developed the wrong-answer creating function to create wrong answers automatically, using a correct-answer keyword, in the multiple-choice question among the problems. This function uses “Word2Vec” to extract the words that are highly similar to the correct answer, and create wrong answers. In this research, we study automatic generation process of the practice problems (learning content) and develop the virtualized educational contents function to customize the practice problems according to the needs of learners. This paper explains the problem-based programming training method and describes the outline of PPL system, the improvement of automatic practice-problem creating function, the wrong-answer creating function and the effectiveness and future research of PPL system.

OS1-2 Automatic incorrect program fragments handling for programming training system CAPTAIN

Masanori Ohshiro, Yorinori Kishimoto, Eiji Nunohiro
(Tokyo University of Informaiton Sciences, Japan)

In this paper, we introduce automatic incorrect program fragments handling to solve this problem. Candidates for incorrect program fragments are randomly chosen from among a set of fragments created from the correct program group prepared for this system as a population. When exercising with this system, the system presents incorrect fragments mixed with correct program fragments. Program fragments sorted by students are checked by compilation, analyzed as semantic graphs by our improved method and compared with semantic graphs of the original program analyzed beforehand. If they are considered to be the same, the student's answer will be correct.

OS1-3 A considerations of characteristic analysis about program source written by students in early education course exercises

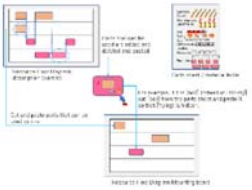
Yorinori Kishimoto, Masanori Ohshiro, Eiji Nunohiro
(Tokyo University of Information Sciences, Japan)

We study on the effect of program code written in beginner. We checked the characteristic of program code written by beginner of university students in class. It is the effective that clearly show the correspondence between class score and program code characteristics. In this education method's puzzle piece, it is effective to written in the effectiveness program source. We had been analysis to these program.We focus on the space character of program code The width of the indentation is clearly show the program structure. In this paper, we propose the characteristic of program code for beginner of university education. And, we show the analysis of this methods and results of this approach and how to write the program piece for PPL.

January 19 (Friday), 13:00–14:30

OS1-4 Practical Problem based Programming Learning using video.

Shigeo Tsukuta, Takashi Yamaguchi, Tatsuya Kano, Yorinori Kishimoto, Eiji Nunohiro
(Tokyo University of Information Sciences, Japan)



In this paper, we proposed an education framework for practical problem-solving based on system designing technologies and an application of proposed framework on video training materials in order to train the skills of modeling and understanding from ambiguous matter in practical problem via non-verbalized video training material. Our framework uses Resource Flow Diagram (RFD) to support the understanding of procedure and resources on problem-solving. RFD is our proposed visualization method for procedure and resource management based on Sequence Diagram in UML. In this experiment, proposed education framework is applied for the understanding of cooking procedure from exhibition video of cooking. Materials and main tools and procedures are shown in the video of cooking. For the verification of effectiveness, we applied the proposed education framework based lecture into information system knowledge and non-knowledge participants. The verification procedure is shown below.

OS1-5 Turtle graphics for early Java programming education

Kenneth J. Mackin
(Tokyo University of Information Sciences, Japan)

This paper introduces a new and original application of turtle graphics to Java programming language, particularly targeted to early Java programming education. The advantages of the proposed implementation is a) the proposed method follows the Java language syntax, so the students do not have to relearn a different language in the future, b) the proposed method hides object oriented programming, so that students can use the turtle graphics features before object oriented programming education, and c) the proposed method integrates other original graphical features including text display, image display, keyboard input, mouse input, and sound play, so that the students are not limited to simple line drawing in the early stages of programming training.

OS1-6 Prototype of Mobile Application of Proactive Action Support System

Yoshihiro Kawano
(Tokyo University of Information Sciences, Japan)

Though proactive action is necessary for career building, it's difficult to behave proactively for several students. The 7 habits is one of powerful schemes for proactive action choice. We are developing proactive action support system by visualization of quadrant II activities called Self-reflector. Self-reflector systematized the first three habits in the 7 habits. However, there were few frequencies for which the examinee uses this system, because this system was not applied for mobile. Periodic and long-term practice is necessary to gain the significant effect of the 7 habits. In this paper, we apply the system to mobile application for promoting of periodic and long-term use of students, called Self-reflector-Plus. To examine our system, we have designed rubric to evaluate effect of Self-reflector-Plus. There are 9 components corresponding habit 1 to 3 in the 7 habits. We are going to examine subject experiment.

January 19 (Friday), 13:00–14:30

Room E

OS16 System control and optimization for IoT technologies

Chair: Kenji Sawada (The University of Electro-Communications, Japan)
Co-Chair: Koichi Kobayashi (Hokkaido University, Japan)

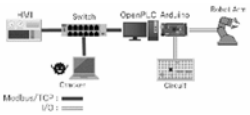
OS16-1 Model-based Anomaly Detection Method for PLC Whitelist

Akinori Mochizuki[1], Kosuke Hata[1], Kenji Sawada[1], Seiichi Shin[1], Shu Hosokawa[2]
([1]The University of Electro-Communications, Japan)
([2]Control System Security Center, Japan)

Recently, defensive countermeasures of the controller are important because cyber-attacks on the control system are growing higher. This paper proposes an anomaly detection method of the whitelist using PLC (Programmable Logic Controller) as one of the countermeasures of the controller. This paper introduces the detection method using constant trace algorithm for the controller. The proposed detection method targets the continuous-valued variables of PLC. It allows PLC to detect the abnormal such as falsification variables.

OS16-2 OpenPLC based control system testbed for PLC whitelisting system

Shintaro Fujita[1], Kosuke Hata[1], Akinori Mochizuki[1], Kenji Sawada[1], Seiichi Shin[1], Shu Hosokawa[2]
([1]The University of Electro-Communications, Japan)
([2]Control System Security Center, Japan)



This paper proposes a security testbed system for industrial control systems. In control systems, controllers are the final fortress to continues the operation of field systems, then, we need countermeasures of controllers. The whitelisting function is efficient in controller security, we need a testbed system to check whether the whitelist function does not effect on other functions of the controller. Industrial controller and its engineering tool are relatively expensive are customized concerning controller vendors. To enhance the whitelist development, this study proposes a testbed system using OpenPLC which an open source software. This system is independent of controller vendors and is applicable for controller programming languages. We implement a whitelist based anomaly detection method for the testbed system and validate that the anomaly detection method operates correctly.

OS16-3 A prototype of cooperative whitelist protection for control systems considering plant life cycle

Takahisa Saito[1], Shion Nasukawa[1], Shu Hosokawa[1], Makoto Kiuchi[1], Kenji Sawada[2]
([1]Control System Security Center (CSSC), Japan)
([2]The University of Electro-Communications, Japan)

Cyber attacks centered previously on information systems has been increasing also in control systems of critical infrastructures such as process and factory automation systems. Control System Security Center (CSSC) proposes a whitelisting countermeasure technology against these cyber attacks. We are studying the implementation of the whitelist for Human Machine Interfaces (HMI), network switches, and controllers that configure control systems. We have found that control systems have some differences in the operation of the system according to its operation mode such as maintenance, normal operation and so on. Utilizing this feature, we have studied a cooperative whitelisting protection method that cooperatively protects plural devices configure control systems. Based on this study result, we created a prototype for realizing cooperative whitelisting protection and verified with a gas simulation plant owned by CSSC. In this paper, we outline this prototype and the verification result.

January 19 (Friday), 13:00–14:30

OS16-4 Markov Chain-Based Modeling Techniques of Appliances for Demand Response

Kenta Ohashi, Koichi Kobayashi, Yuh Yamashita
(Hokkaido University, Japan)

Design of demand response programs in electricity markets is one of the important problems for electricity conservation. In demand response programs, electricity consumption is controlled by electricity prices and incentives (e.g., rewards for load reduction). Then, it is important to develop a mathematical model of consumers. The authors have proposed a new model of consumers called a switched probabilistic model. In this model, the difference between power consumption at the current time and that at the next time is modeled by a discrete-time Markov chain. Furthermore, depending on situations, a discrete-time Markov chain is switched. In this paper, first, we summarize the switched probabilistic model. Next, we propose an on-line algorithm to decide a switching time of Markov chains.

OS16-5 On autonomous distributed operation of LiB combined type SOFC system

Shunsuke Kuwana, Kenji Sawada, Seiichi Shin
(The University of Electro-Communications, Japan)

This paper considers an autonomic cooperative energy system that interchanges electric power through lithium-ion batteries (LIBs) among multiple homes possessing Enefarms. This paper introduces a data field concept of the autonomous distributed system. We formulate information sharing method using mixed integer programming (MIP). We formulate a 2-stage optimization framework to preserve the LIB data field. Focusing on three homes possessing Enefarms, we first show the complexity of the negotiation method and second show that the data field simplifies the autonomic cooperative energy system compared with the negotiation method. Also, the numerical experiment shows that the negotiation method cannot cope with the increase of the number of homes, and shows the possibility of correspondence of information sharing method. Furthermore, we adapt model predictive strategy to the information sharing method. From numerical experiments of the obtained operational scheduling, we consider the change due to the model predictive strategy.

OS16-6 Model Predictive-Based Demand Response in Energy Management Systems

Kodai Miyazaki[1], Koichi Kobayashi[1], Shun-ichi Azuma[2], Nobuyuki Yamaguchi[3], Yuh Yamashita[1]
([1]Hokkaido University, Japan)
([2]Nagoya University, Japan)
([3]Tokyo University of Science, Japan)

In design of energy management systems, aggregators such as retailers play the important role. One of the roles of aggregators is to manage demand response (DR). However, its value is not clear in the whole energy management system. In this paper, model predictive-based DR is proposed, and its value assessment is discussed. First, two kinds of DR problems, i.e., the conventional DR problem and the model predictive-based DR problem are formulated. Next, a numerical example is presented to demonstrate the proposed approach. The proposed approach provides us a fundamental result in design of aggregators.

January 19 (Friday), 15:00–16:00

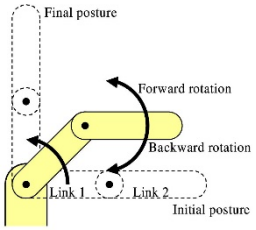
Room F

Poster Session

PS1 Dynamically Evolutional Algorithm for Minimization of the Consumption Energy of a Manipulator

Yoshio Yokose
(Kure College of Technology, Japan)

The global warming and the environmental destruction are caused from the mass consumption of energy in a factory in which robotic manipulators are used. It is necessary to take the trajectory planning into considerations in order to save the consumption energy. It is easy to obtain the optimal solution analytically in a linear system. However, the dynamical equation of the multi-link manipulator is non-linear. In this paper, the angle functions of the manipulator are approximated by the sequence of functions. The coefficients of the function space are searched by using the GA so that the objective function can be optimized with satisfying the boundary conditions. This paper uses the Taylor series and the Fourier series for the approximating function. And, this paper describes an application of the GA to plan the trajectories of a manipulator with non-linear friction and geometric constraints.



PS2 Development of edge server and sensor board for IoT platform

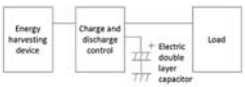
Ryo Katai, Kazuya Okamoto
(National Institute of Technology, Wakayama College, Japan)

IoT is an acronym for "Internet of Things", and it is a generic term for technologies that various kinds of things in the world can control and acquire information by connecting to the Internet. Movements to develop breakthrough systems by applying them to industrial fields are becoming active. Therefore, in this research, we aim to develop a sensor board that detects the situation of industrial equipment and an edge server that aggregates that information. In the proposed system, it is possible to capture digital signals such as operation signals and abnormal signals of equipment and analog signals such as current amount, humidity, and temperature. In addition, it is possible to communicate wirelessly by Twilight and mesh type communication is also possible.

PS3 A study on the power supply system using the energy harvesting device

Shun Yamamoto, Kazuya Okamoto
(National Institute of Technology, Wakayama College, Japan)

In recent years, the energy harvesting technology that extracts weak energy such as light, heat, vibration, radio waves and the like to obtain electric power attracts attention. We propose a power supply system that appropriately charges and discharges tiny electric power obtained by the energy harvesting and stably controls electronic circuits. Finally, we aim to control the electronic circuit for a long period of time with a single charge using a capacitor. We actually prepared a power supply system and controlled the microcomputer with electric power obtained from a solar cell with an output of 1 [mW]. It was possible to control the microcomputer over a long period of time by experiments and confirm the effectiveness of this power supply system.



January 19 (Friday), 15:00–16:00

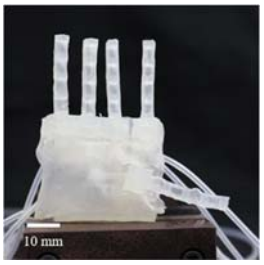
PS4 Development of Stepping-Motor control logic using FPGA

Yudai Tsuchiya, Mutsuki Nakahara, Kazuya Okamoto
(National Institute of technology, Wakayama College, Japan)

In the field of robot speed control, we are proposing a method using FPGA for control of stepping motor which requires high precision. The purpose of the method is realized not only high speed control but also high precision control by achieving both a few MHz response So far, in the speed control field, a method of using a combination of a microcomputer such as the M8 and a driver was adopted for control of industrial robot arm and the like. However, at present, products to be controlled require multifunctional and highly accurate operation and control, and stepping motors are used to perform operations that cannot be achieved with DC motors or single-phase / three-phase motors. In order to realize that control, it is necessary to control the stepping motor at the speed and frequency that cannot be followed by the microcomputer, so now it was realized by designing the ASIC. It has the advantage that it is not only small in size but also high speed because it is designed optimized for the product to be continued. Although, it took a lot of money to develop ASIC, which was a major problem. So we adopted FPGA as an alternative to ASIC.

PS5 Soft robot hand with opposition movement of fingers

Ryohei Shimma, Kenjiro Takemura
(Keio University, Japan)



Humanoid robots are expected to be useful in daily environments around us such as in offices and at homes. In addition to being compact, lightweight and flexible, it is also important for robot hands to be capable of taking various grasping postures including power grasp and precision grasp. Therefore, we focused on the opposition movement of human fingers and proposed a fluid pressure driven robot hand which can grasp various objects and can perform not only power grasp but also precision grasp. The developed robot hand is mainly made of silicone rubber, and we evaluated each element, and conducted object grasping experiment of the robot hand. As a result, we confirmed that seven kinds of precision grasp postures can be realized by giving the opposition movement to the robot hand.

PS6 A method of self-localization for autonomous mobile robot on rough/flat field : Decision of state of field based on threshold value for incline sensor

Shigeki Nakayama, Manabu Inoue, Akitaka Hayashi, Keigo Iwamoto
(National Institute of Technology, Yonago college, Japan)

In this study, we detect multicolor luminous landmarks by omni-directional camera for self-localization. When the robot has inclined, the value of self-localization has been incorrect so that the mapping coordinates of the landmark on the camera have varied in comparison with the coordinates in the case of not inclined. Although we have proposed the modification method for self-localization, the error of self-localization has occurred due to accuracy of incline sensor of the robot. Thereby, we have introduced the threshold value for the output value of incline sensor in order to recognize the state of field.

January 19 (Friday), 15:00–16:00

PS7 A study of integrating noise-robustness feature extraction techniques with the reduced frame-rate acoustic models in mobile-device speech recognition

Jeih-weih Hung[1], Jung-Shan Lin[1], Lee-min Lee[2], Shang-Yu Wang[1]
([1]National Chi Nan University, Taiwan)
([2]Da-yeh University, Taiwan)

In this study, we are focused on developing a novel scheme that achieves noise-robust speech representation and low data-rate transmission. The developed scheme explores the effectiveness of integrating the noise-robust speech feature representation and the reduced frame-rate acoustic model architecture. As for the noise-robust speech features, we adopt three well-known algorithms including cepstral mean subtraction (CMS), cepstral mean and variance normalization (CMVN) and cepstral histogram normalization (CHN). The experiments conducted on the Aurora-2 English connected-digit database shows that: in the clean situation, the adapted HMM with the RFR features provides comparable recognition accuracy relative to the non-adapted HMM with full frame-rate features, while in the various noisy situations, the three noise-robustness algorithms can work very well in the RFR HMM scenarios and improve the recognition performance even when the RFR down-sampling ratio is as low as 1/4.

PS8 Person following control with obstacle avoidance for an intelligent vehicle using enhanced skeleton recognition technique

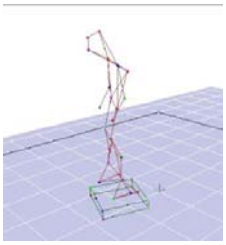
Bing-Shu Lee, Jeih-weih Hung, Jung-Shan Lin
(National Chi Nan University, Taiwan)

This paper develops an intelligent vehicle with obstacle avoidance for person following purpose. The proposed intelligent system can be roughly divided into two major parts: mobile vehicle design and enhanced skeleton recognition. In the portion of skeleton image processing, the system employs Microsoft Kinect to obtain the depth and skeleton information of the moving target, and utilizes the enhanced skeleton recognition to achieve the following control design. When the target is lost, the intelligent vehicle can apply skeleton image recognition to retrieve the target effectively. For the part of following control design, both PID control and fuzzy scheme are employed to improve and enhance the system stability of motors. In addition, the system provides the ability of obstacle avoidance by determining the distance of obstacle with infrared sensors to avoid collision. Therefore, the intelligent vehicle system can successfully achieve the purpose of person following with obstacle avoidance under complex environments.

PS9 Analysis of the influence of balance ability on maneuvering of personal mobility vehicle

Kazuki Obata, Masami Iwase
(Tokyo Denki University, Japan)

The purpose of this research is to analyze the influence of human balance ability on PMV (Personal Mobility Vehicle) boarding. Measurement data of human ability, centroid agitation, and behavior of PMV is required to analyze the influence. Therefore, in order to acquire data, the experimental environment is constructed and the experiment contents are devised. This paper reports on the construction of the experimental environment, the content of the experiment contents and the content of the analysis using the model.

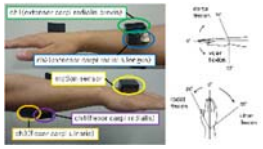


January 19 (Friday), 15:00–16:00

PS10 Validation of a Model to Estimate Body Motion from the EMG Signal - Identification of the EMG model in Volar/Dorsal Flexion of Wrist Using Lasso -

Yuuto Ohno, Jun Inoue, Masami Iwase, Shoshiro Hatakeyama
(Tokyo Denki University, Japan)

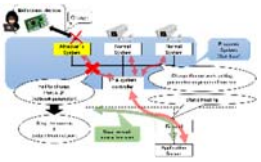
The purpose of this research is to estimate body motion by model considering muscle interaction. In this paper, a model was constructed from the EMG signal and wrist angle during wrist flexion / dorsal flexion, and the wrist angle was estimated based on the model. As a result, we constructed a model that estimates parameters and select terms by using Lasso, and estimates the wrist angle with high accuracy using that model. Moreover, the proposed model can be estimated with almost the same precision as compared with the previous research.



PS12 Proposition and realization of a detection and isolation method for unauthorized network access to an embedded system

Takahiro Moriuchi, Hideo Araki, Sigeru Omatu
(Osaka Institute of Technology, Japan)

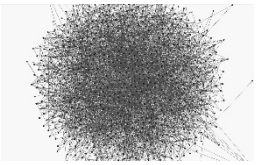
A movement with a spread of IoT (Internet of Things) is getting more active to connect the equipment to the Internet and provide services, in recent years. These connections to the Internet make a possibility of being subjected to a network attack. As responses to these problems, researches aimed at preventing unauthorized intrusions and attacks are currently under way. However, it is difficult to prevent unauthorized intrusion in devices installed in outdoor places, such as surveillance cameras installed outdoors. For example, an attack, that is exchanging an authorized device with an unauthorized device which has a camouflaged address, is worried. Therefore, we propose a system that prevents users from accessing unauthorized equipment by isolating them on the network when illegal devices are detected in this research. In this report, we show the proposed control method, experiments at sending simulated attack packets on our evaluation system, and experimental results.



PS13 The difference of the kurtosis of the average degree distribution between cooperators-dominant and defectors-dominant cases

Tetsushi Ohdaira
(Aoyama Gakuin University, Japan)

The new model proposed in recent years has introduced both activities of breaking and creating connections of every player based on his/her preference into the model of the probabilistic peer-punishment based on the difference of payoff. This new model is not covered by previous studies, and combines the proposed peer-punishment with coevolutionary mechanism that not only strategy of players but also connections between them evolve. The results of this new model have revealed that when investigating the average degree distribution of topology of connections regarding each case where cooperators finally become dominant and defectors finally become dominant, the kurtosis of the average degree distribution of the cooperators-dominant case is larger than that of such distribution of the defectors-dominant case.

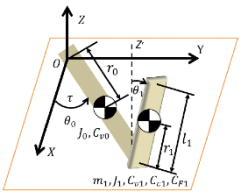


January 19 (Friday), 15:00–16:00

PS15 Simultaneous Design of Mechanism and Control System for Furuta Pendulum considering Friction and Motor Dynamics

Kazuki Nagaki, Shoshiro Hatakeyama, Masami Iwase
(Tokyo Denki University, Japan)

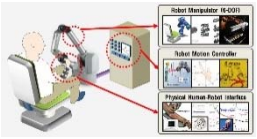
This paper presents a simultaneous design method of mechanism and control for the Furuta pendulum considering friction force and motor dynamics. The design parameters are chosen as the pendulum length and the weighting matrix in the criteria of the LQR linear controller. In this paper, criteria of the simultaneous design problem is desired of the amount of input. And, the design parameter which maximizes the evaluation function are obtained by the simultaneous design method. The effectiveness of the proposed method is verified by numerical simulations with the parameters.



PS16 Human-Robot Cooperation of an Upper Extremity Exercise Robot

Seungyeol Lee, Jeon Il Moon
(Daegu Gyeongbuk Institute of Science and Technology, Korea)

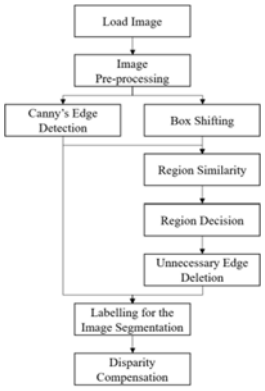
In this paper, the operation of upper extremity exercise robots is discussed in detail in terms of human-robot cooperation. The proposed operating method is applied to the operating program of an upper extremity exercise robot providing three exercise modes: isometric, isotonic, and isokinetic modes depending on the exercise characteristics of users. In addition, because all exercise modes are developed based on the database of the extremity information of users (forearm length of a user, maximum velocity that a user can make, force/torque, etc.), the robot can provide suitable exercise for a particular user. Furthermore, this robot includes an emergency stop function to ensure the safety of users when the robot malfunctions during upper extremity exercises using the three modes and an abnormal state processing function to restart or return to the previous exercise based on the discretion of users.



PS18 Disparity compensation method by using region similarity for stereo matching

Eun Kyeong Kim, Hyunhak Cho, Jongeun Park, Sungshin Kim
(Pusan National University, Korea)

The distance information is used for generating a map of driving environment. Vision sensor has an advantage because it acquires a variety of environment information. In case of stereo images, distance information is related to the disparity. To find the precise corresponding point yields the high accuracy of distance information. However, it is difficult to find corresponding point in case of the untextured region and other reasons. It yields the low accuracy of distance information. Therefore, this paper proposes the method for compensating disparity map by using region similarity and edge detection. Edge detection method can divide an image. Region similarity method is used for determining the similar region. To combine region similarity and edge detection method, the image is separated. Based on the result of image segmentation, experimental result shows disparity map can be compensated. In the future work, it yields high accuracy of the map of driving environment.

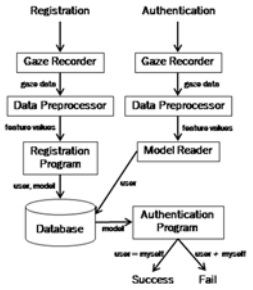


January 19 (Friday), 15:00–16:00

PS19 Personal Authentication Method based on Eye-Tracking Data Mining

Yu Takahata, Tetsuo Tanaka, Kazunori Matsumoto
(Kanagawa Institute of Technology, Japan)

This paper describes an outline of the method for personal authentication based on eye-tracking data, and shows exper-imental results. Several studies clarify that personal characteristics can be found in eye-tracking data, and we now can collect eye-tacking data with low cost without any burden to human bodies. We therefore expect eye-tracking can be effective biometrics in personal authentication. However, many problems remain to put this approach into practical use. In particular, eye-tracking patterns often depend on the knowledge of a person about a target image, and are gradually changes by repeatedly looking similar images. The key point of this study, for solving these problems, is the use of a moving image. In the proposed method, we first show in the computer screen a simple symbol that moves around the other larger figure with a few seconds, and collect eye-tracking data while the subject person is chasing the symbol with eyes. We extract features from the difference between the trajectory of eye-tracking and that of the symbol. We then use machine learning algorithms to build a model to identify persons from features. In this case, we try to use several differ-ent machine learning methods and investigate their performances. And also we try ensemble learning approach by using the weighted voting. The evaluation of these experiments are based on the false reject rate FRR and the false accept rate FAR. This paper describes basic concepts of the system design and experimental results.



PS20 Computer Simulation and Development of 7-linked Biped Walking Robot Embedded with Neural Network Type Central Pattern Generator

Hirotatsu Suzuki, Jae Hoon Lee, Shingo Okamoto
(Ehime University, Japan)

In this paper, as a control method of the biped walking robot, a neural network type Central Pattern Generator (CPG) oscillator was designed and adapted to a simulation model of five-link planar walking robot with circular feet. Furthermore, to achieve more human-like locomotion, a simulation model of a seven-link planar biped walking robot with flat feet was developed, and its parameter identification has been carried out. In addition, an experimental system of the seven-link biped walking robot was developed based on the simulation model. In the end, a neural network type CPG oscillator was installed to the developed robot and its walking experiments were carried out. Also the effect of the sensory feedback on stabilizing the walking motion was investigated through experimental results.

PS21 Velocity Estimation of Moving Obstacles with Accumulated Range Data and Safe Motion Generation of a Mobile Robot Using Artificial Intelligence

Takeaki Takiguchi, Jae Hoon Lee, Shingo Okamoto
(Ehime University, Japan)

This paper presents an intelligent navigation system to generate safe motion of a mobile robot. It consists of two main parts of object recognition and intelligent decision making modules, respectively. Firstly, a recognition algorithm using laser range finder (LRF) and robot odometry is developed to detect objects near the robot. The proposed recognition algorithm provides both position and velocity information of obstacles by using range data accumulated for a certain time period. Then, the result is used for computing a safe direction of the robot to avoid collision with objects. For that, an artificial intelligence algorithm of multi-layered neural network was designed and trained by deep learning method with many data sets of information including pairs of sensor data and its solution for various situations.

January 19 (Friday), 15:00–16:00

PS22 Efficient Ranging Algorithm Using Multiple UWB Wireless Transceivers and Its Application to Position Estimation

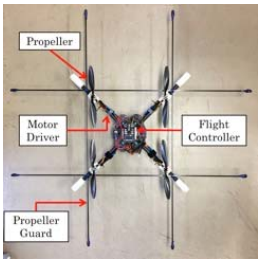
Oh Seong Park, Jae Hoon Lee, Shingo Okamoto
(Ehime University, Japan)

An efficient algorithm to measure ranges between multiple UWB (Ultra Wide Band) transceivers is proposed in this paper. UWB device provides TOF (Time Of Flight) information of communication packet that can be converted to distance. Therefore, it is considered as a potential method for estimating position of an object in indoor environment where GPS cannot be used. Generally, range data between two UWB transceivers is computed with the time for round trip of communication packet because they have different time references respectively. However, it becomes time consuming process in case of ranging between multiple transceivers. The proposed method solves the problem and saves processing time by employing broadcast in communication protocol from tag to multiple anchors. In addition, it is applied to a positioning system and tested through experimental works.

PS23 Development of Autonomous Flight Drone for Inspection Task and Experimental Evaluation of Its Position Estimation System Using Depth Camera

Shinya Kawabata, Hirotatsu Suzuki, Takeaki Takiguchi, Oh Seong Park,
Jae Hoon Lee, Shingo Okamoto
(Ehime University, Japan)

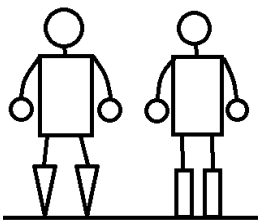
An autonomous drone for inspection task of social infrastructure and its control system are presented in this paper. GPS is widely utilized as a fundamental positioning tool to obtain position of a drone because it provides sufficient performance for autonomous flight in the air. However, it cannot be used when a drone is located near to a building because of multi-paths problem of signal from satellite. A drone for inspection task of social infrastructure is required to have capability of autonomous flight near buildings for efficient work. As the essential function for that, an algorithm to estimate the position of the vehicle itself was investigated and embedded to the developed system. A 3D depth camera was employed to get both depth and image data of surrounding environment. The position estimation was carried out by SLAM (Simultaneous Localization and Mapping) algorithm with depth information. A controller to move the drone autonomously based on the position information was also developed. The system has been evaluated through several experiments.



PS24 Study on Humanoid Robot with Pointed-feet

Takuma Miyazaki, Yuhki Kitazono
(National Institute of Technology, Kitakyushu College, Japan)

Recently working of robot in disaster has attracted a lot of attention. "The DARPA robotics challenge" organized by the US Defense Advanced Research Projects Agency (DARPA) is a humanoid robot competition that operates in a dangerous disaster site. In Japan, we have been working on the development of robots that can work in the places where people can not step, such as "decommissioning robot contest", which assumes work in a devastated, since the accident at the nuclear power plant in Fukushima. Against such a background, in this research we will try to develop walking using the sharp legs as a new system to enable the humanoid robot to walk more effectively in rough terrain. At the moment, the creation of the robot's hardware has been completed.

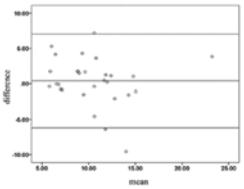


January 19 (Friday), 15:00–16:00

PS25 (ISBC) Comparison of the two noninvasive methods for one-point measurements of arterial stiffness

Kiyomi Niki[1], Motoaki Sugawara[2], Koudai Hirayama[1], Shinsaku Takenouchi[1], Midori Tanaka[2]
([1]Tokyo City University, Japan)
([2]Himeji Dokkyo University, Japan)

The purpose of this study was to compare the two noninvasive methods for one-point measurements of arterial stiffness. Using an ultrasonic system, we simultaneously obtained carotid arterial diameter change waveforms and blood flow velocity waveforms. Diameter change waveforms were used as surrogates for pressure waveforms after calibration by systolic and diastolic pressures measured with a cuff-type manometer. Carotid arterial stiffness parameter β was calculated directly from diameter change and measured pressure change (Method 1). β was also obtained by using the method of one-point pulse wave velocity measurements (Method 2). The mean β from the two methods were significantly correlated. Though there was no fixed bias between the two measurements, proportional bias was observed, which suggested that as arterial stiffness increased, deviations in measurements increased.



January 19 (Friday), 16:00–17:15

Room A

GS3 Artificial intelligence

Chair: Hee-hyol Lee (Waseda University, Japan)

GS3-1 Artificial intelligence, ethics and human values - the cases of military drones and companion robots -

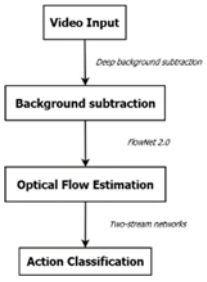
Thibault de Swarte, PfD[1], Omar Boufous[2], Paul Escalle[2]
([1]SRCD Dpt IMT Atlantique, France)
([2]Master's students IMT Atlantique, France)

Can artificial intelligence (AI) be more ethical than human intelligence? Can it respect human values better than a human person? This article examines some issues raised by AI with respect to ethics. The utilitarian approach is a solution, especially the one that uses agents based theory. We have chosen two extreme cases: combat drones, vectors of death, and companion robots, life supporting. The Ethics of AI and unmanned aerial vehicles (UAV) must be studied on the basis of human values when fighting and military ethics. Despite they are not programmed to hurt humans or harm their dignity, companion robots can potentially endanger both their social, moral as well as their physical integrity. An important ethical condition is that companion robots help the nursing staff to better take care of patients and do not replace this staff.

GS3-2 A unified action recognition framework

Amine Ilidrissi, Joo Kooi Tan, Hyoungseop Kim, Seiji Ishikawa
(Kyushu Institute of Technology, Japan)

As action recognition undergoes change as a field under influence of the recent deep learning trend, and while research in areas such as background subtraction, object segmentation and action classification is steadily progressing, experiments devoted to evaluate a combination of the aforementioned fields, be it from a speed or a performance perspective, are far and few between. In this paper, we propose a unified action recognition framework that takes advantage of recent discoveries, fully leverages the power of convolutional neural networks and strikes a speed-accuracy balance not accounted for in most research. We carry out performance evaluation on the KTH dataset and attain a 95.4% accuracy in 200 milliseconds computational time, which compares favorably to other state-of-the art methods.



January 19 (Friday), 16:00–17:15

GS3-3 Developing a Robot that Performs Tasks of Developmental Scales: On Pointing at Pictures

Ryota Tokushima, Hideaki Itoh, Hisao Fukumoto, Hiroshi Wakuya
(Saga University, Japan)

Towards making a robot with a human-level intelligence, we have been developing a versatile robot capable of various behaviors that human beings can perform. In this study, we focus on a task called V31 of the Revised Kyoto Scale of Psychological Development. In this task, a human subject is shown a sheet of paper with six pictures (a dog, a car, etc.) on it and asked to point his/her finger at one of them. For example, the subject is told to point at a dog, and he/she should do that. We have built a humanoid robot to perform this task. The robot searches for the target picture using a deep neural network and moves the arm towards the target using a depth camera. Experiments show that our robot succeeded in achieving V31, except that currently the command has to be given to the robot via a keyboard.

GS3-4 Developing a Robot that Performs Tasks of Developmental Scales: On Copying Drawings

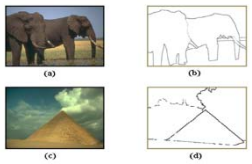
Hidehiko Nakano, Hideaki Itoh, Hisao Fukumoto, Hiroshi Wakuya
(Saga University, Japan)

Towards making a robot that is as intelligent as human beings, we have been developing a versatile robot that can perform various behaviors that human beings can do. In this study, we focus on two tasks called P106 and P107 of the Revised Kyoto Scale of Psychological Development. In these tasks, a human subject is shown a simple line drawing of a cross mark (in P106) and a square (in P107), and asked to draw the same line drawing on a sheet of paper. We have built a humanoid robot that performs these tasks. The given line drawing (a cross mark or a square) is captured by a 3D camera, and the strokes in the drawing are detected by a line-following algorithm that we have built. Then the robot hand is controlled to draw them. Experiments show that our robot successfully achieved both P106 and P107.

GS3-6 Color image edge detection based on a hybrid artificial immune system and microsaccades

Witthaya Sitthivet, Suripon Somkuarnpanit, Kitti Paithoonwattanakij
(King Mongkut' Institute of Technology Ladkrabung, Thailand)

Abstract: Color Edge detection plays an important role in various applications such as image analysis, machine vision and image data compression. It is importance to design an edge detector that will find all the true edges in a natural image. From the ability of immune system to acts to protect our body from bacteria and virus. In this paper, a hybrid algorithm of artificial immune system (AIS) along with microsaccades (rapid eye movements) is proposed for color edge detection. Based on the ability of receptor on immune cells that are recognized in classification of disease and are reinforced with microsaccades and dynamic time warping that helped the AIS to learn Positive and negative samples to find out all feature of edges. The results of this algorithm are tested an edge detector's performance by the figure of merit (FOM).



January 19 (Friday), 16:00–17:00

Room B

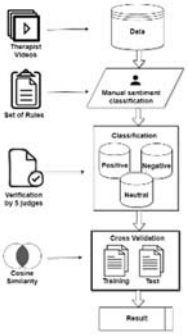
GS4 Bioinformatics & Medical informatics

Chair: Shohei Kato (Nagoya Institute of Technology, Japan)

GS4-1 Classification of advice and warning for therapeutic documents using TFIDF and cosine similarity

Ramachandran Kanagalakshmi, Shohei Kato
(Nagoya Institute of Technology, Japan)

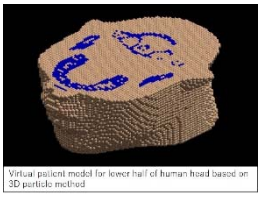
With advances in Human-Robot Interaction, the future rehabilitation support robot can learn from therapist's conversation and can effectively use it to communicate with patients. Most of the therapist's conversations contain advice, warning or general instruction that asks patients to do or follow. The future support robots must understand the difference among advice, warning and general instruction to have a proper communication with patients. This research mainly focuses on classifying therapist's explanations of the therapeutic documents. The first approach, Stanford sentiment classification method finds the polarity of explanation and classifies it into advice (positive), warning (negative) and general instruction (neutral). The second approach, manual sentiment classification method classifies the explanations based on a set of defined rules. The training and test datasets of both classified documents are cross-validated to find the document similarity and to measure the performance.



GS4-2 Development of Virtual Face Model for Palpation Training - Construction of dynamic model with particle method -

Tatsushi Tokuyasu[1], Kenji Yoshitomi[1], Haruka Kikuchi[1], Mai Miyahara[1], Takahiro Yamamoto[1], Kazuhiko Toshimitsu[1], Kazutoshi Okamura[2], Kazunori Yoshiura[2]
([1]Fukuoka Institute of Technology, Japan)
([2]Kyushu University, Japan)

This study proposes a virtual training system for maxillofacial palpation, which can be used in a practical training in dental education. The system comprises one desktop computer for a virtual patient model and a device for haptic interface, and these act interactively each other in a training. Additionally, the virtual patient model non-linearly reacts to a trainee's finger motion, therefore this study applies 3D particle method to develop the dynamic model of the virtual patient model. This paper describes the process of making the virtual patient model based on 3D particle method, and the future issues of our proposal will be discussed.

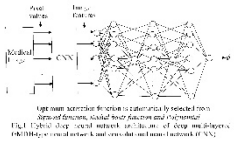


January 19 (Friday), 16:00–17:00

GS4-3 Hybrid deep neural network of deep multi-layered GMDH-type neural network and convolutional neural network and its application to medical image recognition of spleen regions

Shoichiro Takao[1], Sayaka Kondo[2], Junji Ueno[1], Tadashi Kondo[1]
([1]Tokushima University, Japan)
([2]Tokushima Medical Informatics Laboratory, Japan)

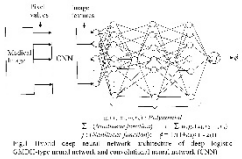
In this study, the hybrid deep neural network of the deep multi-layered Group Method of Data Handling (GMDH)-type neural network and convolutional neural network, is proposed and applied to medical image recognition of the spleen. The deep GMDH-type neural network can automatically organize the deep neural network architectures which have many hidden layers, using the revised heuristic self-organization method which is a type of the evolutionary computation. The deep neural network architectures are organized so as to minimize prediction error criterion defined as Akaike's information criterion (AIC) or Prediction Sum of Squares (PSS). The deep GMDH-type neural network can select useful image features which are generated in the convolutional neural network. This new neural network algorithm is applied to the medical image recognition of the spleen regions and the recognition results are compared with the conventional three-layered sigmoid function neural networks.



GS4-4 Medical image diagnosis of liver cancer by hybrid deep neural network of deep logistic GMDH-type neural network and convolutional neural network

Shoichiro Takao[1], Sayaka Kondo[2], Junji Ueno[1], Tadashi Kondo[1]
([1]Tokushima University, Japan)
([2]Tokushima Medical Informatics Laboratory, Japan)

The hybrid deep neural network of the deep logistic Group Method of Data Handling (GMDH)-type neural network and the convolutional neural network, is proposed and applied to the medical image diagnosis of liver cancer. In the deep logistic GMDH-type neural network algorithm, many hidden layers are automatically generated to fit the complexity of the medical images by using the revised heuristic self-organization method. The convolutional neural network generates the medical image features and the deep GMDH-type neural network can select the useful image features and organize the deep neural network architectures using the selected useful image features, so as to minimize the prediction error criterion defined as AIC or PSS criterion. In this study, the hybrid deep neural network is applied to the medical image diagnosis of liver cancer and these recognition results are compared with those obtained using the conventional three-layered neural network.



January 19 (Friday), 16:00–17:30

Room C

OS7 Intuitive Human-System Interaction (Part II)

Chair: Masao Yokota (Fukuoka Institute of Technology, Japan)
Co-Chair: Naoto Iwahashi (Okayama Prefectural University, Japan)

OS7-1 Proposal of an Integrated Common Platform for Zoo Operation Support

Tatsuya Ohyanagi, Hayato Ito, Misaki Iyobe, Tomoyuki Ishida
(Ibaraki University, Japan)

In this paper, we constructed an Integrated Common Platform for zoo operation support. This system consists of the animal ledger management system, the animal health record management system, the animal diary management system, the veterinarian diary management system, the event management system, the animal feed management system, and the veterinarian data management system. We realized unified management of various information in zoo operations. Moreover, we realized quick and accurate data retrieval by database of zoo operations.

OS7-2 Proposal of a Historical Materials Presentation AR System for Local Activities and History Education

Hayato Ito, Tatsuya Ohyanagi, Misaki Iyobe, Tomoyuki Ishida
(Ibaraki University, Japan)

In this paper, we propose a Historical Materials Presentation AR System for local activities and history education.This system consists of the mobile application and the AR contents management system. The mobile application acquires the AR content according to the current location. The AR content management system is a data management Web application for registering, editing and deleting contents of AR contents and voice guidance used in the mobile application. In order to evaluate the effectiveness of the Historical Materials Presentation AR System, we carried out a questionnaire survey of 45 subjects. As a result, high effectiveness was confirmed.

OS7-3 Kansei Retrieval Method by Principal Component Analysis of Japanese Traditional Crafts

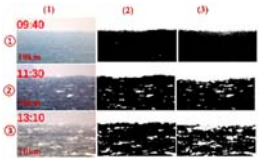
Misaki Iyobe[1], Tomoyuki Ishida[1], Akihiro Miyakawa[2], Yoshitaka Shibata[3]
([1]Ibaraki University, Japan)
([2]Nanao-city, Ishikawa, Japan)
([3]Iwate Prefectural University, Japan)

In this paper, we propose an AR mobile application using Kansei retrieval method based on principal component analysis of Japanese traditional crafts. In order to build a knowledge base to perform a Kansei retrieve, we performed a principal component analysis on the relation between traditional crafts and Kansei words. As a result, we extracted six principal components from the eigenvalue problem of the correlation matrix based on the standardizing variables. In addition, we classified traditional crafts into three types by principal component analysis and mapped them on the two-dimensional plane. As a result, we analyzed the tendency of components of traditional crafts.

January 19 (Friday), 16:00–17:30

OS7-4 Long distance sea wave extraction method based on improved Otsu algorithm

Ying Yang, Cunwei Lu
(Fukuoka Institute of Technology, Japan)



Sea wave extraction is the foundation of sea wave measurement, which plays a significant role in binocular stereo vision based tsunami early warning system. Sea wave extraction means extracting sea waves out from sea surface image. The commonly used extraction methods may lose sea wave information or lead to over extraction, because of sea surface images' ununiformed luminance, and low signal to noise ratio respectively. In this paper, we improved Otsu algorithm to realize dynamic multi threshold algorithm for sea wave extraction. First we divide the original image into small blocks and figure out dynamic multi threshold according to local sea surface illuminance. Then we define an evaluation function to add constraint condition to adjacent block's threshold. Finally, we extract sea waves out using the block's threshold in all the blocks. By experimental results we can know that, more sea waves are extracted correctly than Otsu algorithm

OS7-5 3D modeling of cultural property gardens and utilization for acceleration of disaster reconstruction

Shiki Kou[1], Kazuki Satoh[1], Akio Doi[1], Kenji Sakakibara[2], Tomonaru Hosokawa[2],
Masahiro Harada[3], Tadaaki Konno[4]
([1]Iwate Prefectural University, Japan)
([2]TOKU PCM Ltd., Japan)
([3]Tack Engineering Ltd., Japan)
([4]Morioka City, Japan)

In this research, we digital-archived a cultural property garden, "Nanshoso" in Morioka city. We conducted two kinds of 3D measurement techniques. The first is to take picture by using UAV with a high resolution camera from the sky. The second is to use 3D laser measurement device from the ground. The point cloud data was generated from the high resolution camera images by using 3D shape reconstruction software with Structure of Motion technology. Next, we integrated both the point cloud data and a laser measurement data, and we constructed 3D CAD model by using these point cloud data. Finally, we tried to convert point cloud data into conventional drawing data (2D drawing), and evaluated the results and the effectiveness of our approach.

OS7-6 A scene search method using subtitles appended to lecture video for supporting self-learning

Kaoru Sugita
(Fukuoka Institute of Technology, Japan)

In Japan, the information technology (IT) is an important issue in educational fields. Many students can become to study using multimedia contents in anywhere and anytime. However, Japanese students spend short time on self-learning compared with other countries. Considering this fact, we propose a multimedia switching system to improve their learning time and understanding. In the system, multimedia contents are provided to reflect both knowledge and skills for keeping a self-learning time, motivation and understanding. The system is an educational content to switch their operation, media, quality reflected as a learning support functions. However, we have not focused on usability of educational contents. In this paper, we discuss a scene search using subtitles appended to lecture video implemented as a Web application for supporting self-learning.

January 19 (Friday), 16:00–17:15

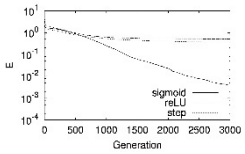
Room D

GS10 Evolutionary computations (Genetic algorithm)

Chair: Hiroshi Furutani (Doshisha University, Japan)

GS10-1 Investigation of Multi Layers Neural Network Performance Evolved by Genetic Algorithms

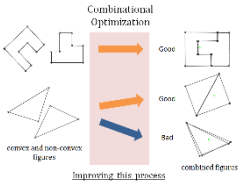
Job Isaac Betere, Hiroshi Kinjo, Kunhiko Nakazano, Naoki Oshiro
(University of the Ryukyus, Japan)



This paper presents a study on the investigation of multi-layers neural networks (MLNNs) performance evolved with genetic algorithm (GA) for multi logic training partners applied to various network functions. Specifically, we have concentrated on the Sigmoid, Step and ReLU functions to evaluate and simulate their performances in the network. We have revealed that GA training gives good training results in evolutionary computation by changing of sigmoid, ReLU and Step as the activity functions in MLNN performance. Sigmoid function has proved to train all patterns for both outputs without any challenge as seen for the ReLU function and Step in the study. We are still trying to see how a ReLU function could be trained with GA for MLNNs performance for the two inputs and four output training patterns termed as the multi logic partner training. key words: multi-layer neural networks, learning performance, multi logic training patterns, genetic algorithms and deep learning

GS10-2 Solution to the packing problem of polygons using genetic algorithm

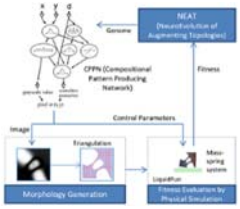
Kenta Fujisawa[1], Shudai Ishikawa[1], Ryosuke Kubota[2]
([1]National Institute of Technology, Oita College, Japan)
([2]National Institute of Technology, Ube College, Japan)



In this paper, we present a solution for two-dimensional irregular strip packing problem as the introduction of three-dimensional irregular packing problem. We adopt Genetic Algorithm (GA) as the solution method for the problem. In our method, as the individuals of the genetic algorithm, the convex and non-convex polygons (the pieces) are handled, and they are allowed free rotation. We applied our method to some pairs of pieces; it was succeeded to obtain a good solution regarding complex figures. Contrary, however, it could not obtain a good solution regarding simple figures. We focus the evaluation criterion, adding a criterion using the area of the piece to the optimization process. In this paper, we verify the effectiveness of the new evaluation criterion of the GA for the two-dimensional irregular strip packing problems.

GS10-3 Evolving morphology and control for virtual soft-robots with a particle-based soft-body simulation

Lin Wang[1], Michal Joachimczak[2], Reiji Suzuki[1], Takaya Arita[1]
([1]Nagoya University, Japan)
([2]CiNet, National Institute of Information and Communications Technology, Kyoto, Japan)

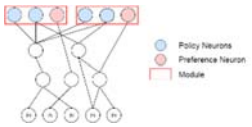


In this paper, we present a new system to evolve both morphology and control for soft-bodied robots in 2-dimensional space. The representation of robot is encoded by Compositional Pattern Producing Networks (CPPN). As an abstraction of development, CPPN generates both morphology and distributed controllers for robots. Soft-bodied robots' motion is simulated as a mass-spring system using the 2D particle and rigid-body physics simulation environment, LiquidFun. We evolve many creative robot patterns, some displaying mechanisms of locomotion highly similar to those of real animals. Our results show there is a great potential in this approach to evolve creative soft-bodied robots morphologies with matching distributed actuation mechanisms and at much higher resolutions and visual detail than found in previous works.

January 19 (Friday), 16:00–17:15

GS10-4 Multiobjective Optimization in One-Player Mahjong Using MM-NEAT

Koya Ihara, Shohei Kato
(Nagoya Institute of Technology, Japan)



In Mahjong, there are several objectives at play in a hand to win the game. These objectives often conflict with each other, thereby creating tradeoffs. In this paper, we propose an evaluation function for Mahjong in the form of a multiobjective optimization problem. Further, Mahjong requires multimodal behavior, e.g., aiming to win or fold, win early or gain a large number of points. Modular multiobjective NEAT (MM-NEAT) is a framework to evolve modular neural network. Each modules defines a separate policy. Evolution optimize these policies and when to use them. Given the above, we focus on two objectives in one-player Mahjong: to (1) win early and (2) gain a large number of points. We also attempt to verify the effectiveness of MM-NEAT for Mahjong.

GS10-5 Optimizing L^2-Distance-Based Estimation Model by Firefly Algorithm

Syo Nishihara, Tomoharu Nakashima
(Osaka Prefecture University, Japan)

When analyzing uncertain data expressed by a set of data points, calculating the density difference between any two sets of data points is an important task. Least squares density difference (LSDD) estimator which uses a non-parametric model approximates the true density difference accurately. In the previous method, it searches for the parameters of the model by using the grid search. However, there is no guarantee that the obtained parameters by the grid search are optimal, we apply a firefly algorithm which is suitable to the multimodal optimization problem for the parameter search. Numerical experiments are conducted to show that the LSDD estimator by using the firefly algorithm approximate the true density differences and L2-distances more accurately than the grid search.

January 19 (Friday), 16:00–17:00

Room E

GS6 Cognitive science

Chair: Timothée Levi (The University of Tokyo, Japan / University of Bordeaux, France)

GS6-1 A Survey of Analyzing Understanding Process of Programming by Using Eye Tracking

Shimpei Matsumoto[1], Shuichi Yamagishi[1], Tomoko Kashima[2], Yusuke Hayashi[3], Tsukasa Hirashima[3]
([1]Hiroshima Institute of Technology, Japan)
([2]Kindai University, Japan)
([3]Hiroshima University, Japan)

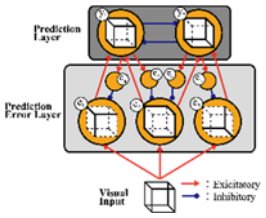
Many Programming learners in the lowest group do not have even a minimum knowledge to read a simple program properly than writing a program consisting of dozens of lines. Reading programs would be an essential programming learning. Therefore, in programming introduction education, supporting for reading programs must play an important role. Based on this idea, in order to effectively support the learners in the lowest group, firstly we should conduct a basic analysis of reading programs to unveil their features. Therefore, the authors focused on eye tracking as a method to carry out the idea. The authors have thought that utilizing eye movement helps to clarify the reasons for making programming learning difficult. Therefore, the purpose of this paper is to confirm whether the eye tracking is useful for estimating the reading process of programs by focusing on previous works discussing on eye tracking for programmer's feature extraction.

January 19 (Friday), 16:00–17:00

GS6-2 Neural network model of perceptual alternation enhanced by visual mismatch process

Yuki Tsuruoka, Tomokazu Urakawa, Osamu Araki
(Tokyo University of Science, Japan)

Elucidating the mechanism of obtaining one stable perception from a bistable image is one of the primary goals of visual neuroscience. Many studies have been done on endogenously alternates, but little is known about the mechanism of exogenous perceptual alternation. Recently, a psychophysiological experiment reported that detection of a change in a visual sequence induced perceptual alternation in proportion of amplitude of vMMN (Urakawa et al. 2017). Thus, the present study aims to construct a neural network model to simulate the perceptual alternation facilitated by a neural signal reflecting the vMMN enhancement. We succeeded to simulate the exogenous perceptual alternation, using the model based on predictive coding theory. The results suggest that the vMMN has a role to announce a prediction error to related cortical areas and the exogenous perceptual alternation is enhanced by this effect.



GS6-3 Perception of an aperture based on average distances among objects: Development of a simulator to examine the validity of the proposed hypothesis

Hirotaka Takahashi, Kazuyuki Ito
(Hosei University, Japan)

Real creatures, such as insects, birds, and animals, can act quickly in a complex real environment and pass in between objects without crashing. They have no distance sensor, and cannot measure the exact size of gaps. In addition, they do not know the absolute size of objects or gaps. They can only use the relative size of objects in the image obtained by their eyes. Nevertheless, they can estimate whether their body can pass through a gap or not using only visual information. In our previous works, to explain this ability, we made a hypothesis that the average distance among objects in an environment is utilized to estimate the size of gaps. In the present study, we developed a simulator of visual information to demonstrate the validity of our proposed approach. The output image of this simulator consists of many dots, and information on the object size is removed. We confirmed that we can perceive a gap from the motion of the dots, and the perceived size of the gap depends on the average distance among the objects.

GS6-4 Formulating what a deceived person thinks

Seiko Myojin, Noboru Babaguchi
(Osaka University, Japan)

The problem that old people are sometimes deceived by remittance fraud has become a great concern in our society. This paper formulates a deceived person's thinking using a framework called Channel Theory, which is a qualitative framework of information flow and is suited for modeling communication among people or artifacts. A previous work reported that Channel Theory could formulate the situation where a person interpreted information correctly or incorrectly. We think the situation is similar to remittance fraud because the situation is telephone conversation and the criminal of the fraud uses a victim's misconception to impersonate somebody. We introduce the logical formulas to describe communication of typical remittance fraud, and discuss their ability to express the situation where a person is deceived or not deceived.

January 19 (Friday), 16:15–17:15

Room F

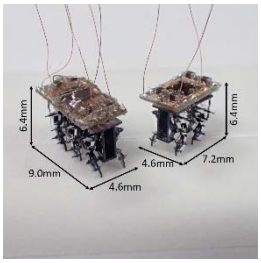
OS14 Robotics: Design and Intelligence

Chair: Maki K. Habib (The American University in Cairo, Egypt)
Co-Chair: Fusaomi Nagata (Tokyo University of Science, Yamaguchi, Japan)

OS14-1 Neural networks IC controlled multi-legged walking MEMS robot with independent leg mechanism

Satoshi Kawamura, Daisuke Tanaka, Taisuke Tanaka, Daisuke Noguchi, Yuichiro Hayakawa, Minami Kaneko, Ken Saito, Fumio Uchikoba
(Nihon University, Japan)

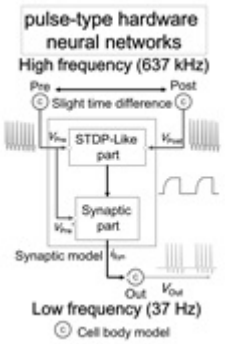
In this paper, we will compare the walking behavior of two types of multi-legged walking MEMS robot. The independent leg mechanism and the neural networks IC control applied to both robots as a biomimetics. Independent leg mechanisms can actuate the single leg by single artificial muscle wire. Two independent leg mechanisms compose the leg modules which can connect each other to increase the numbers of legs. This paper compares the quadruped and hexapod walking behavior of MEMS robot. Neural networks IC can control the quadruped walking of the robot. Also, hexapod walking can control by adding the peripheral circuits to neural networks IC. As a result, the authors show the quadruped walking perform as 24.6 mm/min and hexapod walking perform as 27.0 mm/min. The result shows the hexapod walking are advantageous than quadrupled walking in the case of the millimeter-sized robot.



OS14-2 Spike-timing-dependent plasticity model for low frequency pulse

Masaya Ohara, Mizuki Abe, Minami Kaneko, Ken Saito, Fumio Uchikoba
(Nihon University, Japan)

The authors are studying pulse-type hardware neural networks for generating the driving waveform of the robot. The P-HNN generates driving waveform by the oscillatory pattern. Oscillating frequency depends on the time constant of the oscillator. In the case of implementing into the integrated circuit (IC), a large time constant cannot integrate into the limited space. This paper is discussing the generation of low-frequency pulse without using a large time constant. Two cell body model pre-synaptic neuron (pre) and post-synaptic neuron (post) generate the high-frequency pulse (637 kHz). A slight time difference of both pulse waveform integrated to the slight voltage difference of spike-timing-dependent plasticity (STDP) model. The integrated slight voltage difference indicates the coupling coefficient of pre and post. The value of coupling coefficient changing slowly thus, the output neuron (out) generates the burst-like waveform which can use as low-frequency pulse (37 Hz).

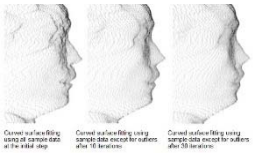


January 19 (Friday), 16:15–17:15

OS14-3 Iterative Curved Surface Fitting Algorithm Using a Raster Scanning Window

Fusaomi Nagata[1], Akimasa Otsuka[1], Takeshi Ikeda[1], Hiroaki Ochi[1], Keigo Watanabe[2], Maki K. Habib[3]
([1]Tokyo University of Science, Yamaguchi, Japan)
([2]Okayama University, Japan)
([3]The American University in Cairo, Egypt)

In this paper, a free-formed surface fitting method using a small sliding window is first proposed to smooth the original organized point cloud data (PCD) with noise and fluctuation. Samples included in a small sliding window positioned in PCD are successively fitted to a quadratic surface from upper left to lower right using a least squares method. In the iterative process, outliers of samples are asymptotically removed based on a evaluation index. This proposed method allows original PCD to be smoothed keeping its own shape feature. Then, a STL generator is proposed to produce triangulated patches from the smoothed PCD. The process allows to reconstruct 3D digital data of a real object written with STL format for reverse engineering from original PCD with noise. The effectiveness and usefulness of the proposed system are demonstrated through actual smoothing and machining experiments.



OS14-4 Biomimetics and Bioinspiration: Design and Creativity

Maki K. Habib[1], Fusaomi Nagata[2]
([1]The American University in Cairo, Egypt)
([2]Tokyo University of Science, Yamaguchi, Japan)

Biomimetics aims to use nature as a model of inspiration that would help conscious abstraction of new principles and ideas that inspire creative design. It is important to understand the conditions that allow such approach to produce a bioinspired design that help to transfer ideas from nature to engineering. Smart materials are the foundation supporting the development of new biomimetic based technology. Wide range of biologically inspired robots and intelligent systems has been developed. However, engineering such biomimetic intelligent creatures were hampered by physical and technological constraints that continue to be a challenge. Designing new robots and intelligent machines that can move and perform its assign task using biologically inspired artificial muscles would create new reality with great potentials. This paper provides the concept and the importance of Biomimetic as an interdisciplinary field. In addition, the paper introduces nature as a principle source of inspiration to design for creativity and highlight the best design practices that leads to consistent and inherently sustainable design. Furthermore, it discusses scientific ideas and directions of research activities in the field and finally it underlines the potential of the field and the challenges facing it.

January 20 (Saturday), 09:00–10:00

Room A

GS5 Chaos & Complexity

Chair: Seiko Myojin (Osaka University, Japan)

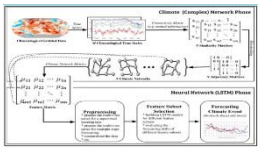
GS5-1 Cellular Automata in Fractal Arrangement

Yoshihiko Kayama
(BAIKA Women's University, Japan)

Cellular automata (CAs) have been successfully used to investigate complex phenomena across a broad range of research fields. Standard CAs can be extended by applying a novel algorithm known as the recursive estimation of neighbors. This process allows the construction of non-uniform CAs that are composed of cells with perception areas and different radii. This paper proposes a non-uniform CA called Fractal CA, which is composed of cells with self-similar fractal arrangement. By focusing primarily on the extension of 1D elementary CAs, certain characteristics of standard CAs are carried over into Fractal CAs, including pattern replicability and reversibility of the additive rules.

GS5-2 El niño-southern oscillation forecasting using complex networks analysis of LSTM neural networks

Clifford Broni-Bedaiko[1], Ferdinand Apietu Katsriku[1], Tatsuo Unemi[2], Norihiko Shinomiya[2], Jamal-Deen Abdulai[1], Masayasu Atsumi[2]
([1]University of Ghana, Ghana)
([2]Soka University, Japan)



Arguably, El Niño-Southern Oscillation (ENSO) is the most influential climatological phenomenon that has been intensively researched during the past years. Currently, the scientific community knows much about the underlying processes of ENSO phenomenon, however, its predictability for longer horizons, which is very important for human society and the natural environment is still a challenge in the scientific community. Here we show an approach based on using various complex networks metrics extracted from climate networks with long short-term memory (LSTM) neural network to forecast ENSO phenomenon. The preliminary experiments show that training LSTM model on network metrics time series dataset provides great potential for forecasting ENSO phenomenon longer multiple steps ahead.

GS5-3 Alife-based approach to analysis method of local community for resident-centered local community vitalization

Koya Kimura[1], Yurika Shiozu[2], Kosuke Ogita[1], Ivan Tanev[1], Katsunori Shimohara[1]
([1]Doshisha University, Japan)
([2]Aichi University, Japan)

A community is a system that cannot exist without community people's self-motivated involvement in itself, and that composes of humans, "Mono," "Koto" and their relationality. "Mono" in Japanese here denotes tangible and physically perceived thing/entity, while "Koto" denotes intangible and cognitively conceived thing/entity. In other words, a local community is a typical example of adaptive complex systems, and can be modeled and simulated by multi-agent systems approach. In that sense, it should be possible to employ Alife-based approaches to analyzing and designing a local community. As the first step to apply an Alife-based approach to a local community, in this paper, we investigated methods to analyze a local community. We visualized the relationships between experimental cooperators by each day using the collected passing-each-other data. As a result, we confirmed that each experimental cooperator formed various clusters by each day.

January 20 (Saturday), 09:00–10:00

GS5-4 An evolutionary model for emergence of inter- and intra-specific diversity in behavioral plasticity and personality

Masanori Tsuchiya, Reiji Suzuki, Takaya Arita
(Nagoya University, Japan)

Social interactions among individuals or species have been discussed as key factors for the inter- and intra-specific diversity in behavioral plasticity and personality. However, there have been few approaches that discussed differences in diversification process at these different levels using a single framework in this context. We construct an agent-based evolutionary model in which several individuals participate in a partitioning of their shared niches, and evolve their behavioral plasticity and genetic preference to avoid an overlap of their niche use, assuming two types of group composition based on inter- or intra-specific interactions. We show the similar types of diversity at inter- and intra-specific levels emerged in that the small number of species or individuals with high plasticity could coexist with many individuals or species with low plasticity and personality when there exists an intermediate degree of resource competitions, which were realized by different mechanisms.

January 20 (Saturday), 09:00–10:30

Room B

OS2 Bio-inspired theory and application (1)

Chair: Kunihito Yamamori (University of Miyazaki, Japan)

OS2-1 A novel audio fingerprinting method based on music elements for similar music retrieval

Taiga Aoshima, Kunihito Yamamori, Masaru Aikawa, Kentaro Inoue
(University of Miyazaki, Japan)

Music consist of three fundamental music elements: rhythm, melody and harmony. The conventional audio fingerprinting methods for fast music retrieval are based on the acoustic features only, they do not consider to the features from the musical point of view, and it is impossible to use similar music retrieval. In this paper, we propose a novel audio fingerprinting method for similar music retrieval focusing on the three fundamental music elements. Our method extracts features of music elements and translates them into audio fingerprints. We evaluate our audio fingerprinting system by experiments using actual music. As a result, our method could generate audio fingerprints from the viewpoints of music elements, and these audio fingerprints could express the similarity between music.

OS2-2 Reinforcement learning approach for smart air traffic control support system

Masato Watanabe, Kunihito Yamamori, Masaru Aikawa, Kentaro Inoue
(University of Miyazaki, Japan)

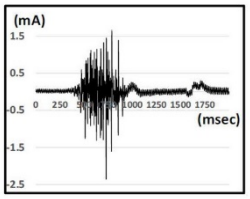
In this paper, we aim to derive the best ATC instructions by machine learning for air traffic control at landing. We use Reinforcement Learning (RL) to decide ATC instruction. RL is one of the machine learning to learn policies to select an action of agent at the specific situation in virtual simulation environment. RL agent learns how to control the air traffic flow as air traffic controllers to prevent aircraft collisions. We evaluated the proposed method under the condition that 100 aircrafts appear at every 5 minutes and start to descend for an airport from some entry points.

January 20 (Saturday), 09:00–10:30

OS2-3 A study on user identification method using cross-correlation and SVM to realize an authentication system by s-EMG

Tokiyoshi Kurogi[1], Hisaaki Yamaba[1], Kentaro Aburada[1], Tetsuro Katayama[1],
Mirang Park[2], Naonobu Okazaki[1]
([1]University of Miyazaki, Japan)
([2]Kanagawa Institute of Technology, Japan)

At the present time, mobile devices such as tablet-type PCs and smart phones have widely penetrated into our daily lives. Therefore, an authentication method that prevents shoulder surfing is needed. We are investigating a new user authentication method for mobile devices that uses surface electromyogram (s-EMG) signals, not screen touching. S-EMG signals are generated by the electrical activity of muscle fibers during contraction. Muscle movement can be differentiated by analyzing the s-EMG. Taking some advantage of the characteristics, we proposed a method that uses a list of gestures as a password in the previous study. In this paper, we investigated the performance of the new set of feature values that includes eleven kinds of values. We also adopted cross-correlation to improve the reliability of data sets that are used to train SVMs. Experiments were carried out to confirm the effectiveness of the method.



OS2-4 Parallel Asynchronous Particle Swarm Optimization on Many-core Processors

Ayumi Kamizuru, Kazuki Takabatake, Yuji Sato
(Hosei University, Japan)

A parallel PSO algorithm with basic implementation will frequently access to the global memory although accessing to the global memory takes a longer time than accessing to local memories. To avoid accessing to the global memory, we present a parallel distributed PSO algorithm that consists of subgroups of particles; Each subgroup has the best fitness of particles of the group itself, so that each subgroup behaves as a PSO without accessing the global memory. We show that execution time will be reduced by separating threads into two groups. We compared the execution time and the accuracy of a basic parallel PSO algorithm and the proposed algorithm. The experimental results show that our method takes a shorter execution time at some kind of functions.

OS2-5 A Resources Pre-allocated Bare Bones Particle Swarm Optimization Algorithm

Jia Guo, Yuji Sato
(Hosei University, Japan)

The bare bones particle swarm optimization algorithm is wildly used in the different area. But it suffers at local optimal when dealing with multimodal functions. To solve this problem, a resources pre-allocated bare bones particle swarm optimization (RPBBPSO) algorithm is proposed in this work. Particles are divided into two groups before evaluation according to their personal best position. One group named digging group (DG) and the other one called the exploring group (EG). The DG focuses on digging and trying to find the optimal point in the current local optimum. Conversely, the EG aims at exploring the research area and giving the whole swarm more chances to escape from the local optimum. The two groups work together to find the global optimal in the search area. Finally, a set of well-designed experiments confirm the optimization ability of the RPBBPSO.

January 20 (Saturday), 09:00–10:30

OS2-6 Parallelization methods for moving objects extraction based on SLIC

Yuta Kambara[1], Masaru Fukushi[1], Toru Abe[2]
([1]Yamaguchi University, Japan)
([2]Tohoku University, Japan)

Accurate and fast extraction of moving object regions from image sequences is indispensable for various applications such as visual surveillance and robot vision. In this paper, we propose parallelization methods for moving objects extraction based on SLIC. Considering the superpixel generation process is independent from each cluster center, the proposed method for multi-core CPUs parallelizes the process by the unit of cluster center and uses SIMD operations. Also, the proposed method for GPUs divides the generation process of superpixels into several subprocesses and parallelizes it by the unit of subprocesses. Evaluation result showed that the proposed method for multi-core CPUs reduced the processing time by 72% and that for GPUs by 83%.

January 20 (Saturday), 09:00–10:00

Room C

GS15 Neural networks

Chair: Fusaomi Nagata (Tokyo University of Science, Yamaguchi, Japan)

GS15-1 Study on missing value estimation method by cooperation of multiple self-organizing map

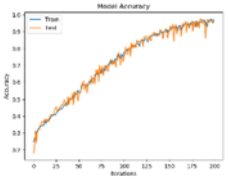
Masakazu Arita, Yuya Esaki, Nobuhiro Okada
(The University of Kitakyusyu, Japan)

The purpose of this research is to improve the accuracy of missing data estimation of data by SOM. In this research, we use multiple SOMs that has been developed in our laboratory in order to make the estimation more effective. Multiple SOMs technique is not affected by the missing rate because they can use defect example for the learning. Each SOM of multiple SOMs ignores different variables, and thus the multiple SOMs can do things impossible with SOM alone. It is one of the great advantages of multiple SOMs to be able to estimate even when there is no complete data no other estimation methods. In this study, we simulated a large number of data to show that the loss estimation is accurate. As a result, we could confirm that the missing value could be estimated even when the missing rate was 100%.

GS15-2 Multi-layer Perceptron Neural Networks for Classification and Recognition the Scattering Patterns of Scanning Electron Microscopy Images

Manop Phankokkruad[1], Sirirat Wacharawichanant[2]
([1]King Mongkut's Institute of Technology Ladkrabang, Thailand)
([2]Silpakorn University, Thailand)

This work applied the MLP neural network to classify and recognize the scattering pattern of polymer materials in SEM images. We have created the appropriate MLP neural network model that suits the classification of these images. We created our own dataset based on the model and characterized the dataset to adjust the model structure and training methods. We tested our model on the created in two different datasets. This dataset consists of ten classes of different patterns. The experiment results have shown that the MLP neural network model could significantly enhance the classification and recognition of the SEM images. In which way, this work could solve the problem of false interpretation of the polymer material morphology and improve the efficiency of classification obviously. The results showed that the MLP neural network could classify the scattering pattern of SEM images with an accuracy of 97.87% and 2.98% of error.



January 20 (Saturday), 09:00–10:00

GS15-3 Peculiarity classification of flat finishing motion for skill training by using torus type self-organizing maps

Masaru Teranishi, Shinpei Matsumoto, Nobuto Fujimoto, Hidetoshi Takeno
(Hiroshima Institute of Technology, Japan)

The paper proposes an unsupervised classification method for peculiarities of flat finishing motion with an iron file, measured by a 3D stylus. The classified personal peculiarities are used to correct learner's finishing motions effectively for skill training. In the case of such skill training, the number of classes of peculiarity is unknown. A torus type Self-Organizing Maps is effectively used to classify such unknown number of classes of peculiarity patterns.

GS15-4 Memory Network for Classification Tasks

Hidekazu Yanagimoto
(Osaka Prefecture University, Japan)

Many researchers pay attention to deep learning and proposed various kind of neural network architectures. The researches usually generate more complicated architecture and neglect understanding of the network processing. It prevents applying the system to decision making in the real world. On the other hand, other statistical machine learning approach based on mathematical theory is more interpretable. So a goal is to construct more interpretable network architecture. In Support Vector Machines (SVM), which is one of statistical machine learning approaches, discriminative function is constructed based on training data, support vectors. So I aim to construct a neural classifier based on training examples strictly. The proposed method is a classifier with memory network. The memory network has a memory to keep training data and can construct a discriminative function with the memory in the sparse fashion. I apply the proposed system to general classification tasks and evaluate their performance. From some evaluation experiments I find the proposed method achieve the similar

January 20 (Saturday), 09:00–10:15

Room D

GS8 Data mining 1

Chair: Ryo Hatano (Tokyo University of Science, Japan)

GS8-1 DEA cone ratio model based on a paired comparison

Yuto Kamitaka, Shingo Aoki, Kazushige Inoue
(Hiroshima Institute of Technology, Japan)

Data Envelopment Analysis (DEA) is well known as evaluation method to measure the efficiencies of Decision making units (DMUs) relatively with multiple inputs and outputs items. In order to analyze the DEA results continuously, this paper proposed the DEA framework. A proposed framework consists of two following steps: (1) extracting subjectivity information based on a paired comparison, (2) extending the traditional DEA model. The proposed model does not add restrictions to a variable directly and it is formulated in the form where it corrects the search direction, “No solution” does not come out of it. Since the proposed model is correcting the search direction, an analyst's intention is incorporated without taking out an execution impossible solution.

January 20 (Saturday), 09:00–10:15

GS8-2 The Degree of Robustness based on Hierarchical DEA

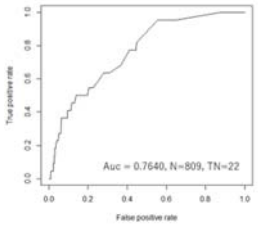
Kazushige Inoue, Shingo Aoki
(Hiroshima Institute of Technology, Japan)

Data Envelopment Analysis(DEA) is the method to evaluate efficiency values of Decision Making Units (DMUs), and the hierarchical DEA model has been developed. Although analysts can evaluate the efficiency structure of input and output items by this model, they cannot figure out how robust efficiency values of DMUs are. In order to overcome this problem, we propose the degree of robustness based on the hierarchical DEA model. We formulate the proposed degree based on the efficiency value of each combinations of input and output items, the number of input and output items of each combination and parameter p. This parameter p implies analysts' intention about importance on not characteristic nodes against the characteristic nodes. Analysts can evaluate robustness of efficiency considering all input and output items by the proposed degree.

GS8-3 Development of Prediction Model for the Degree of Needed Support with UPI

Chikako Miyamoto, Naoko Furukawa, Tatsushi Tokuyasu
(Fukuoka Institute of Technology, Japan)

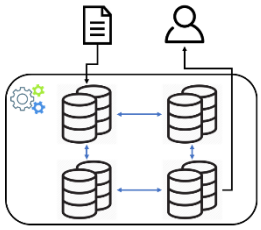
This paper proposes a prediction model to estimate the possibility of that college students will have a trouble which needs a certain support based on the questionnaires for the assessment of mental heath degree. This study focused on the University Personality Inventory student mental health investigation (UPI). From the UPI data of 809 students we have prepared for the basic research of this study, 22 students who used the counseling. This study applies our UPI data to the logistic regression analysis in order to a prediction model. Since The AUC of 76.4% is not enough as the screening system, we discuss the strategy to improve the accuracy of logistic regression model.



GS8-4 A proposal of multi distributed database management system

Chong Guo, Takayasu Fuchida, Tadanori Hisanaga, Bo Chen
(Kagoshima University, Japan)

In recent years, the size of data is being bigger and bigger every day. So, a problem of Relational Database Management System (RDBMS) is discovered, that is RDBMS could not process these big data on the Internet. So, a new type database was developed, it is called NoSQL. But every NoSQL database has its unique characteristics and programming language, even architecture. So how to make it fast about writing and reading the big data among the NoSQL databases is the problem at present. For that, we decide to build a system to solve this problem. In this system, databases can connect with each other and synchronous each other's data in back end. And when user import a file, this system can choose a fastest writing database to write. On the other hand, when user want to search something, this system can choose a fastest reading database to search.



GS8-5 A study on learning method of Word2Vec for recommending predicates of Open Data

Bo Chen, Takayasu Fuchida, Tadanori Hisanaga, Chong Guo, Daisuke Noto
(Kagoshima University, Japan)

In recent years, the worldwide interest in Open Data has been increasing. The utilization of Open Data has been promoted, and many organizations are working on opening and utilizing Open Data. In this research, we focused on the vocabulary that corresponds to the predicate of the RDF form for Open Data, we propose a method to learn word vectors by utilizing the neural network called Word2Vec in order to share the vocabulary. We get the csv file from Open Data of local governments that have already been published, and extract the specified column from the csv file. Next we separate the data by the word segmentation, and make a data file where one word is listed in one line. Further, we use Word2Vec to find a word vector from the dictionary for each word and display ten highest-ranking words from the core vocabulary and the whole word dictionary.

January 20 (Saturday), 09:00–09:45

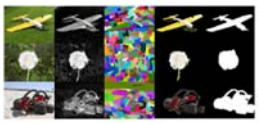
Room E

GS16 Robot vision and image processing 1

Chair: Kikuhito Kawasue (University of Miyazaki, Japan)

GS16-1 Development of a Support System for Human Communication Based on the Visualization of Words

Kazuya Motoyama, Joo Kooi Tan, Seiji Ishikawa
(Kyusyu Institute of Technology, Japan)



The communication between humans only by talk is sometimes unclear and may lead a listener to unintended ideas. This misunderstanding can be eliminated in some cases by showing images of a speaker's concern. In this paper, a system is proposed for supporting human communication based on the visualization of words. The proposed system generates images corresponding to the visual words which a speaker utters, by which it aims at eliminating the ambiguity in conversation and facilitating communication between humans. In order to create user-specific database, it is necessary to collect object images automatically in individual daily activities. Therefore we perform automatic object detection from images. We use a saliency map and image segmentation for the object detection. By using this bottom-up type detection, it is possible to record various kinds of object images in the personal database. Some simulated conversations were considered and used in an experiment and expecting results were obtained.

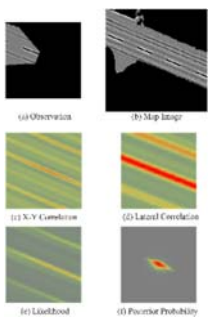
GS16-2 Application for precision agriculture using radio control helicopter - A part of user-friendly information sharing system -

Tomoko Kashima[1], Takashi Hasuike[2], Shimpei Matsumoto[3]
([1]Kindai University, Japan)
([2]Waseda University, Japan)
([3]Hiroshima Institute of Technology, Japan)

A model that connects producers, consumers, and farmers' markets was developed, and an information system was developed as a communication tool in order to collate the experience- and intuition-based know-how of producers and improve the value of their crops. However, the elderly comprise over 60% of the population employed in agriculture, and farmers are unwilling to utilize information technology (IT) devices. In an effort to increase the IT utilization rate, a proof-of-concept test was conducted up to 2016 at a roadside station. Therefore, in this study, we design a new IT tool that connects producers with consumers. In this study, as a part of the information sharing system function for producers, one of the available functions supports precision agriculture by rice producers. The functions are introduced below.

GS16-4 Mono-Camera based vehicle localization using Lidar Intensity Map

Keisuke Yoneda[1], Ryo Yanase[1], Mohammad Aldibaja[1], Naoki Suganuma[1], Kei Sato[1,2]
([1]Kanazawa University, Japan)
([2]DENSO CORPORATION, Japan)



This paper reports an image-based localization for automated vehicle. The proposed method utilizes a mono-camera and an inertial measurement unit to estimate the vehicle pose. Self-localization is implemented by a map matching technique between the reference digital map and sensor observations. In general, the same types of sensors are used for map data and observations. This study is focused on the mono-camera based method using Lidar-based map for the purpose of a low-cost implementation. Image template matching is applied to provide a correlation distribution between the captured image and the predefined orthogonal map. A probability of the vehicle pose is then updated using the obtained correlation. The experiments were carried out for real driving data on an urban road. The results have verified that the proposed method estimates reasonable positioning errors on real-time.

January 20 (Saturday), 10:45–11:45

Room A

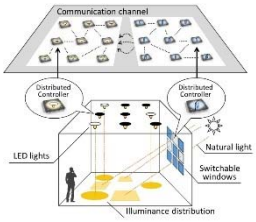
GS14 Multi-agent systems

Chair: Tetsushi Ohdaira (Aoyama Gakuin University, Japan)

GS14-1 Development and control of distributed lighting control system

Yuta Takamoto[1], Yuki Minami[2], Kenji Sugimoto[1]
([1]Nara Institute of Science and Technology, Japan)
([2]Osaka University, Japan)

We propose a distributed lighting control system that enables provision of a desired illuminance distribution. The proposed system is composed of multiple LED lights, and switchable windows that can change their transparency independently. Distributed controllers are embedded in all lights and windows, and they communicate to determine the proper lighting and shading patterns needed to realize a desired illuminance distribution. In this study, we first formulate a design problem that finds distributed controllers that move the actual illuminance distribution closer to the desired one. Then, we propose an autonomous distributed algorithm that solves the proposed design problem. Finally, we verify the algorithm's effectiveness via simulations and real-world experiments with a developed system.



GS14-2 LoversFlow v2: an individual-based evo-eco simulator on sexual dimorphism - A challenge toward evolutionary aesthetics -

Tatsuo Unemi, Hiroaki Matsumoto
(Soka University, Japan)

This paper presents the design of our individual-based evo-eco simulator targeting an evolutionary process on sexual appearance, preference, and dimorphism, including sex-influenced traits. The simulator can manage some thousands of individual agents in continuous 2D space for birth, roaming, mating, reproduction, separation, and death. It also has some auxiliary functions for monitoring and recording the evolutionary process for visualization and further statistical analysis. Some results are also shown as example analysis concerning effects of distance bias from view points of speciation and dimorphism. By expanding the complexity of appearance so as to include shape, texture, and the other features of subjects in the research on computational aesthetics, it will be able to contribute to seek the origin of beauty.

GS14-3 Study on dangerous sensations for pedestrians when bicycles pass

Kanta Ueki[1], Shota Okamoto[2], Tatsushi Tokuyasu[2], Takanori Tanaka[1]
([1]National Institute of Technology, Oita College, Japan)
([2]Fukuoka Institute of Technology, Japan)

In this paper the authors aim to propose the design of a bicycle and a pedestrian track that reduces pedestrians' dangerous sensations through virtual space. This paper, as a preliminary experiment, investigates subjects' dangerous sensations putting on a head mount display (HMD) on the condition that the running speed of a bicycle that person driving and interval distance between a bicycle and a pedestrian are different when they are passing each other in the HMD and examines the factors affecting the dangerous sensations of subjects by using logistics regression analysis the data of which is the result of the investigation.

January 20 (Saturday), 10:45–11:45

GS14-4 Proposal of a flexible robot navigation method based on majority consensus

Yuichiro Sueoka, Yusuke Tsunoda, Takahiro Ide, Koichi Osuka
(Osaka University, Japan)

This paper proposes a navigation method for artificial creatures like autonomous mobile robots. The key tricks of our proposed method are as follows; one is majority consensus and the second is dynamical switching of individual preference to the destination. After deriving the group model with two subpopulations, we introduce normal-type robots, what we call, the assist robots (defined as those who lack a preference at first). The aim is to switch dynamically the group destination by adding the normal-type robots to the preference to a destination. We show that from the statistical simulations, the group destination can be dynamically switched and controlled by adding the preference to the normal-type robots. The result also indicates that a flexible navigation (dynamical switching of the destination of entire group) is performed only by changing the subgroup controller.

January 20 (Saturday), 10:45–12:15

Room B

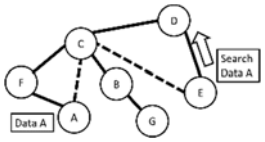
OS3 Bio-inspired theory and applications (2)

Chair: Kunihito Yamamori (University of Miyazaki, Japan)

OS3-1 Lightweight Virtual Node Protocol for large scale IoT device networks

Yuta Shinooka, Kunihito Yamamori, Masaru Aikawa, Kentaro Inoue
(University of Miyazaki, Japan)

A report by Ministry of Internal Affairs and Communications says that the number of IoT devices will reach 30 billion by 2020. MQTT is a lightweight publish/subscribe messaging protocol designed for M2M (machine to machine) telemetry in low bandwidth environments, but it has a disadvantage that the server load will become high when a lot of IoT devices join the network. In this paper, we propose a Lightweight Virutual Node Protocol (LVNP). Since most Internet-of-Things(IoT) devices are battery-powered equipments, we design the LVNP based on User Datagram Protocol for low electric power consumption. We select Peer-to-Peer (P2P) approach to avoid intensive communication between servers and IoT devices. To validate feasibility of the LVNP, we investigate the relation between the number of uplinks/downlinks and search hit ratio. Experiments showed that a node needed two uplinks and more than seven downlinks to keep more than 80 percent search hit ratio when the network consisted of 500 nodes.

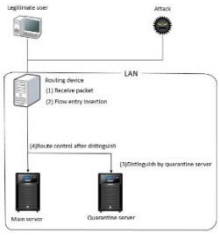


January 20 (Saturday), 10:45–12:15

OS3-2 Introduction of traffic characteristics to distinguish legitimate user traffic from DDoS attack traffic

Yuki Arikawa[1], Hisaaki Yamaba[1], Kentaro Aburada[1], Tetsuro Katayama[1],
Mirang Park[2], Naonobu Okazaki[1]
([1]University of Miyazaki, Japan)
([2]Kanagawa Institute of Technology, Japan)

DDoS attack is a serious threat in the current information society where the Internet plays an important role as social infrastructure. We have been studying mitigation this attack using a method to distinguish between legitimate users and attacks. However, the previous method was not suitable to distinguish between legitimate users and attacks because the previous method analyzes only an access log. In this study, we propose a new method that can distinguish between legitimate users and attacks even if the services running. As a result of the experiment, we confirmed that the proposed method can distinguish between legitimate users from attacks.



OS3-3 An impact-echo testing method using self-organizing map

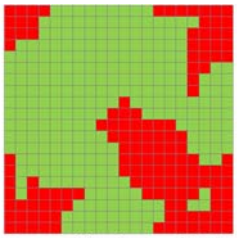
Takumu Shimada[1], Hiroto Komatsu[1], Yuuki Kawahara[1], Noriyuki Utagawa[2], Chitose Kuroda[2],
Ikuo Yoshihara[3], Moritoshi Yasunaga[1]
([1]University of Tsukuba, Japan)
([2]Technical Research Institute, Sato Kogyo Co.,Ltd, Japan)
([3]Miyazaki University, Japan)

The purpose of this research is to increase accuracy of the impact-echo method for concrete defect-detection by applying SOM (Self-Organizing Map) to the method. SOM has been applied to the impact-echo method for similarity-visualization of defects in some actual concrete structures, but not to the defect-detection yet. In the SOM learning, we used a learning data set that were taken from a standard concrete specimen, in which artificial defects were embedded. And the detection accuracy was measured using test data sets that were taken from three regions in an actual concrete bridge, which were judged as all normal, or no-defect by a skilled human-examiner. In the two regions, we obtained high detection, or judgement accuracies of 92% and 80 % using the SOM. In contrast, however, rather low accuracy of 55% was also measured in one of the three regions.

OS3-4 Hardware implementation of a self-organizing map using a zynq FPGA and its application to impact-echo testing

Hiroto Komatsu[1], Takumu Shimada[1], Yuuki Kawahara[1], Noriyuki Utagawa[2], Chitose Kuroda[2],
Ikuo Yoshihara[3], Moritoshi Yasunaga[1]
([1]University of Tsukuba, Japan)
([2]Technical Research Institute, Sato Kogyo Co.,Ltd, Japan)
([3]Miyazaki University, Japan)

A hammering test is one of the inspection methods with which an inspector hears an echo-sound reflected from the concrete hit by a hammer, and examines if there exist defects or not. This inspection has some problems that there are differences in results depending on the inspector's experience, the difference among individuals, etc. An automatic hammering test called impact-echo testing has been thus developed and used widely. In this paper, we combined the impact-echo testing with Self-Organizing Map (SOM) to improve the defect detection rate, and also proposed a novel specialized hardware for SOM to accelerate its calculation with a small amount of hardware resource. We achieved high recognition accuracy of 92.09% for test data collected from an actual concrete structure under the proposed hardware architecture, and hardware complexity, or resource could be reduced less than half of the conventional neuron circuit for SOM.


Competitive layer of SOM
(20 × 20 neurons)

January 20 (Saturday), 10:45–12:15

OS3-5 A Fault-tolerant Routing Method with Double-ring for 2D torus Network-on-Chips

Kohhei Ohkuma, Masaru Fukushi
(Yamaguchi University, Japan)

This paper deals with the issue of fault-tolerant packet routing for 2D torus Network-on-Chips (NoCs). Existing methods called region-based fault-tolerant routing methods have the drawback that the number of packets passing through the nodes on detour paths is larger than that passing through normal nodes, which leads to network congestion and increase in communication delay. In this paper, we propose a fault-tolerant and deadlock-free routing method for 2D torus NoCs by extending the region-based fault-tolerant routing method originally designed for 2D mesh NoCs. To alleviate the network congestion, the proposed method forms duplicated detour paths called double-ring and switch them dynamically. Performance evaluation indicates that the proposed method with double-ring reduces the average latency of packet transmission by about 80% compared with the existing method.

OS3-6 A fault-tolerant routing method for 2d-mesh network-on-chips based on a partial fault model

Yoshiki Jojima, Masaru Fukushi
(Yamaguchi University, Japan)

The advent of Network-on-Chip (NoC) systems motivates its use in wide range of applications such as multimedia and computer vision. This paper deals with the fundamental issue of fault-tolerant routing for realizing high performance and dependable NoCs. The major drawbacks of the existing methods are low node usability and high communication latency. In this paper, we introduce a new concept of partial fault model and propose a fault-tolerant routing method for 2D mesh NoCs. Unlike most existing methods where entire nodes are regarded as faulty, the proposed method allows to treat partially faulty nodes with limited routing functions. Simulation results obtained by a cycle accurate custom simulator show that the proposed method reduces the number of unused nodes and improves communication latency by up to 83% and 79%, respectively, compared with the exiting methods.

January 20 (Saturday), 10:45–12:15

Room C

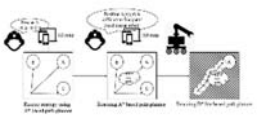
OS8 Learning and Control

Chair: Hee-hyol Lee (Waseda University, Japan)

OS8-1 Improved 3D Node based Optimal Algorithm with Position Estimation for First Responder

Shin-nyeong Heo[1], Jiahua Yu[1], Ji-Sun Shin[2], Hee-hyol Lee[1]
([1]Waseda University, Japan)
([2]Pusan National University, Korea)

This paper proposed a navigation system for first responders in disaster environment. First responders are needed 3D navigation system or devices for searching difficult environment such as partially known position information, large variability of terrain information, crowed obstacles or etc. It needed for fast path planning in urgent situations. Therefore, an integrated 3D path planning method that reduces arrival time and calculation time in various node based optimal algorithm is needed. In addition, position estimation method is needed to related to node based optimal algorithm for GPS navigation. Thus, this paper proposed a novel 3D path planning algorithm called Grid level updated algorithm and position estimation methods using Kalman fitler and Bayes method.

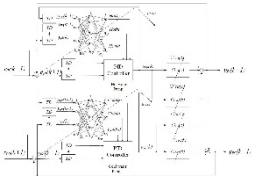


January 20 (Saturday), 10:45–12:15

OS8-2 Neuro PID Control using Self-Learning for Ultra-Compact Binary Power Generation Plant

Kun-Young Han, Hee-Hyol Lee
(Waseda University, Japan)

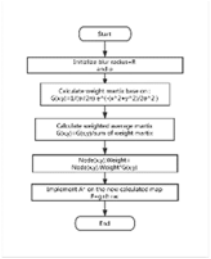
A 5kW class ultra-compact binary power generation plant converts thermal energy into electric power using temperature difference between heat source and heat sink. It is necessary to consider a method to keep optimal control performance when any negative effects vary parameters in the plant. The neural network (NN) is one of the most promising strategies to control an ultra-compact binary power generation plant because of its abilities with flexibility and learning ability. A Neuro PID control method with functionality of self-learning was developed and tested in order to optimal control the invested plant by simulation. In the Neuro PID control method, the neural network learned based on the control error, and the tuning parameters of the PID controller obtained as the outputs of the neural network directly. Simulation results show the Neuro PID controller could achieve the satisfactory control performance.



OS8-3 Improved Node Based Optimal Path Planning Algorithm with Box Blur Method

Jiahua Yu[1], Shin-nyeong Heo[1], Ji-Sun Shin[2], Hee-hyol Lee[1]
([1]Waseda University, Japan)
([2]Pusan National University, Korea)

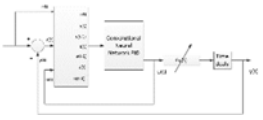
Node based path planning algorithms, such as A*, D* and D*lite, are only concentrate on the smallest move cost from start node to goal node. The calculated path by these algorithms is located on the edge of obstacles or terrains. However, we want that robots keep a distance from the obstacles to be safe in real situation. In this research, we propose a upgraded A* path planning method with different terrain adapted with Box blur method, which is able to make the transmission between walkable node and obstacle node become smooth and the calculate path will keep a safe distance from obstacles, which will avoid collisions and scratches.



OS8-4 Convolutional Neural Network PID Control for Thermal Fusion Bonding of Panel

Ziang Wei, Hee-Hyol Lee
(Waseda University, Japan)

Thermal fusion bonding of panel is an important process of LCD production, and uniformity of the thermal fusion bonding process is important. However, several environment conditions affect characteristics of the panel. The characteristics of large size panel are especially varying with the fusion bonding process. To make the process to be stable and quick, a Convolutional Neural Network PID control is proposed in this paper. Fast responses of the heating process and uniform heating are realized by the Convolutional Neural Network PID control.



January 20 (Saturday), 10:45–12:15

OS8-5 Stochastic Optimal Control for Traffic Signal of Asymmetrical Intersection based on DBN Model

Chengyou Cui[1], Jinlan Quan[1], Heehyol Lee[2]
([1]Yanbian Univerity, China)
([2]Waseda Univerity, Japan)

In this paper, a stochastic optimal control method for traffic signals of asymmetrical intersection is proposed. A modified cellular automaton (CA) traffic model and a dynamic Bayesian network (DBN) model are used to predict the traffic jams. Here, calculation method for priori probabilistic of outflows at different traffic signals is modified based on actual situation. In addition, a PSO algorithm is used to search optimal traffic signals based on the stochastic model. Finally, the effectiveness of the proposed method is shown through simulations at an asymmetrical intersection using a micro-traffic simulator.

OS8-6 An Effective Criterion for Estimating Drowsy Driving

Youngdal Oh[1,2], Sunhong Park[1], Dongwoon Ryu[1], Hee-hyol Lee[2]
([1]Korea Automotive Technology Institute, Korea)
([2]Waseda University, Japan)

Technical trend of drowsy driving monitoring systems divided into three methods. Nevertheless, these methods are faced with a problem such as signal noise with driving environment. This means that a large number of driving data were needed. Fur-thermore, there is a lack of quantitative evaluation indicators in order to classify into two categories. In this paper, we focus on founding an effective criterion for estimating drowsy driving from a driving situation. For this, we conducted driving experi-ments of subjects utilizing VRDS. Next, we classified their conditions into normal and drowsy driving, and synchronously ac-quired the 13 parameters is closely related to the drowsiness. Finally, we have analyzed the results of various classification learner techniques to distinguish drowsiness of driver when using the above parameters alone or in combination. As a result, we are able to extract the most effective indicator among a lot of them.

January 20 (Saturday), 10:45–12:00

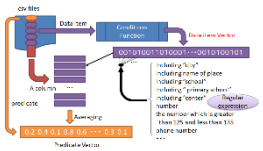
Room D

GS9 Data mining 2

Chair: Masaru Teranishi (Hiroshima Institute of Technology, Japan)

GS9-1 A proposal of recommendation method of predicates for Open Data using statistical method

Tadanori Hisanaga, Takayasu Fuchida, Daisuke Noto, Bo Chen, Chong Guo
(Kagoshima University, Japan)



In recent years, the use of big data and open data is promoted, and a number of organizations, including national and local governments are working to take advantage of open data. However, in these disclosed data formats are still many file formats depending on the format of the particular application or CSV format and data collaboration has not yet been utilized. In this study, we propose a method to recommend common predicates according to data by using statistical processing to link data. In the open data of the CSV format, the item names of the data are arranged in the first row, and the data items are stored in after the second line. In order to measure the approximation of these item names, we calculated an average of item vectors in which features of data items of a specific column are arranged and using predicate vectors as the average of the item vectors. And we investigate what kind of features including the data. Based on the result, we determined the judgement condition of the item vector, and calculated the predicate vector. Clustering of item names is done using SVM and we propose a system to recommend a common namespace.

GS9-2 Development of VR system for the assessment of the crisis in passing of a bicycle

Shota Okamoto[1], Akitsugu Tanaka[1], Taro Oyama[2], Chikako Miyamoto[1],
Takanori Tanaka[2], Tatsushi Tokuyasu[1]
([1]Fukuoka Institute of Technology, Japan)
([2]National Institute of Technology, Oita College, Japan)

This paper investigates the environmental condition of that a pedestrian senses the crisis against the passing bicycle. As the background of this study, the increment of the number of accidental contact between a bicycle user and a pedestrian has been recognized as one of the significant social issues. The purpose of this study is to clarify the environmental condition related to the sensibility of a pedestrian from the view point of psychology. In this paper, a virtual simulator that enables a test subject to experience the crisis due to the passing bicycle was developed. A variety of the environmental conditions were simulated and the weights of each condition were quantitatively evaluated by using logistic regression analysis. For future, this study will validate the simulation results by comparing to the experimental results implemented in the actual environment.

January 20 (Saturday), 10:45–12:00

GS9-3 Server Failure Detection using Parallel Computation of Logic based Machine Learning

Takuma Shimada, Ryo Hatano, Hiroyuki Nishiyama
(Tokyo University of Science, Japan)

Server failure detection is often set rules for system metrics manually by system operators. But the way is difficult because the environment of servers has become increasingly complex. In addition, system operators are often obliged to submit detailed reports in case of failure. In this research, we present a system which tells us the method of server failures based on a technique of Inductive Logic Programming (ILP). ILP is a logic based machine learning, and it can generate rules based on first-order predicate logic(FOL). Since first-order logic is an appropriate language for describing the relationships, and it is easy for humans to read. In this works, we try our method to apply the DoS attacks, and show that obtained rules contains we get some rules with complicated relations, including time-series elements.

GS9-4 Correlation analysis between human feeling and quantitative evaluation criteria

Ryosuke Saga
(Osaka Prefecture Unviersity, Japan)

This paper describes the verification about quantitative evaluation criteria of edge bundling. Recently edge bundling method is used for reducing visual clutter in graph drawing area. Actually several methods have been proposed and in order to evaluate these edge bundling methods, the author proposed evaluation criteria based on aesthetics rules. However, of relationships between human cognition and the criteria. In order to clear the relationships, we collected almost 39 persons' questionnaires and found correlations in two of them.

GS9-5 Feature Extraction from RoboCup Soccer Game Logs for Predicting the Game Results

Tomoharu Nakashima, An Ohori, Takuya Fukushima
(Osaka Prefecture University, Japan)

This paper investigates the feature extraction of soccer matches for predicting the game results. RoboCup soccer simulation is employed for this task. A game log is generated after completing a soccer game in the RoboCup soccer simulation. Although the game log includes various information obtained during the course of the soccer game such as the position and velocity of the players and the ball, the player's body angles, stamina, communicated messages, and actions that were taken at each time step of the game. We consider to convert the information contained in the game logs into useful features such as the number of passes, dribbles, ball possession rates. As these features are calculated for each time step, the accumulated values of the features will be used for the prediction of the game results.

January 20 (Saturday), 10:45–11:45

Room E

GS17 Robot vision and image processing 2

Chair: Keisuke Yoneda (Kanazawa University, Japan)

GS17-2 3D reconstruction of living space using laser scanner and camera image

Yamone Hla Win[1], Kikuhito Kawasue[1], Touryu Kawano[1], Kumiko Yoshida[2]
([1]University of Miyazaki, Japan)
([2]Koyo Machinary Works Co. Ltd, Japan)

The three-dimensional measurement system of indoor space visual reconstruction systems has been developed. Most of these reconstruction systems operate only in limited environment. Therefore, two types of indoor space 3D visual reconstruction system are introduced. First system is human-operated and is equipped with a laser scanner, CCD camera, omnidirectional camera and a computer. The derived three-dimensional indoor space condition is reconstructed by considering the movement and direction of the mobile cart. The system enables us to measure the target indoor space with high accuracy without the use of GPS. The second system uses optical devices (i.e. cameras, laser scanner...) mounted on a stationary rotating platform to capture multiple images used to form a panoramic image and point cloud data for a 3D visual representation of space. These two systems are able to capture and reconstruct the indoor space in three-dimension system.

Fig. 8 Reconstructed data using mobile cart

GS17-3 3D measurement of moving target using multiple slits with random dots pattern

Myat Hsu Mon[1], Kikuhito Kawasue[1], Kouki Tokieda[1], Kumiko Yoshida[2]
([1]University of Miyazaki, Japan)
([2]Koyo Machinary Works Co. Ltd, Japan)

The measurement system of moving objects using multiple slits projection method with random dots is introduced. In implementing the measurement of moving object, the proper detection of moving objects from a single image is required on considering the unique image of the slits with random dots pattern. The robust technique to extract the moving object from the image is introduced in this paper for reducing the inappropriate influence of random dots. Generally, the calibration required manual cumbersome task using a scale. In this paper, semi-automatic calibration method is introduced. Using this technique, the calibration process is greatly simplified without reducing the accuracy.

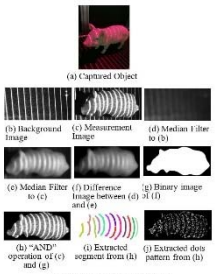


Fig. 2. Object Extraction Process

GS17-4 Construction of remote operation system of a mobile robot arm using image information and P control

Noboru Tagami[1], Yoshitaka Matsuda[1], Takenao Sugi[1], Satoru Goto[1], Naruto Egashira[2]
([1]Saga University, Japan)
([2]National Institute of Technology, Kurume College, Japan)

In this research, a remote operation system of a mobile robot arm is constructed by employing image information and P control. The system is developed by improving an existing remote operation system, where the system mainly consists of a robot arm, a mobile robot, a USB camera, a microcomputer and two PCs. After the robot is moved by manual operation of a human operator, it is autonomously operated by combining image processing with P control. In order to verify the reproducibility, experiments of pressing a button were performed. As a result, the success rate of the remote operation was improved by the proposed remote operation system.

January 20 (Saturday), 10:45–11:45

GS17-5 Bone Erosions Detection on Hand CR Images Based on DCNN (ISBC)

Seiichi Murakami[1,2], Kazuhiro Hatano[1], Huimin Lu[1], Joo Kooi Tan[1],
Hyoungseop Kim[1], Takatoshi Aoki[2]
([1]Kyushu Institute of Technology, Japan)
([2]University of Occupational and Environmental Health, Japan)

Although radiographic assessment of joint damage is essential in characterizing disease progression and prognosis in patients with rheumatoid arthritis (RA), it is often difficult for trained radiologists to find radiographic changes on hand and foot radiographs because lesion changes are often subtle. This paper proposes a novel quantitative method for automatically detecting bone erosion on hand radiographs to assist radiologists. First, the proposed method performs with the crude segmentation of phalanges regions from hand radiograph and extracts the detailed phalanges regions by the multiscale gradient vector flow (MSGVF) Snakes method. Subsequently, the region of interest (ROI; 40 × 40 pixels) is automatically set on the contour line of the segmented phalanges by the MSVGF algorithm. Finally, these selected ROIs are identified by the presence or absence of bone erosion using a deep convolutional neural network classifier. This proposed method is applied to the hand radiographs of 30 cases with RA. The true-positive rate and the false-positive rate of the proposed method are 80.5[%] and 0.84[%], respectively. The number of false-positive ROIs is 3.3 per case. Therefore, the proposed method is useful for supporting radiologists in imaging diagnosis of RA.

January 18 (Thursday), 09:00–10:30

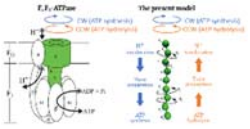
Room B

ISBC OS1 Biological and visualization systems

Chair: Ken Naitoh (Waseda University, Japan)
Co-Chair: Hideo Miyachi (Tokyo City University, Japan)

ISBC OS1-1 Geometric angle shifts of helical filaments and elastic power transmission

Mengyun Li, Shiori Uda, Tomohiro Yanao
(Waseda University, Japan)



This study explores the significance of geometric angle shifts of a short helical filament induced by internal twist propagation. We employ a prototypical model of biological filaments consisting of nine mass points connected with eight springs, where all the seven bending angles and six dihedral angles have linear elasticity, and all adjacent dihedral angles are coupled linearly. Because of the coupling between dihedral angles, twisting waves can propagate through the filament. We demonstrate that the helical filament can change its orientation about its helical axis under conditions of zero total angular momentum as a result of propagating a twisting wave. This change in orientation is the manifestation of the geometric angle shift. We argue that the twist propagation and the resulted geometric angle shift of the helical filament may serve as a model of the elastic power transmission and the rotary motion of the central shaft of ATP synthase.

ISBC OS1-2 New quasi-stable size ratios appearing in biomolecular and subatomic particles revealed by the multi-dimensional Taylor expansion series

Tomotaka Kobayashi, Ken Naitoh, Shu Nemoto
(Waseda University, Japan)

The multi-dimensional Taylor expansion series is applied to find new quasi-stable size ratios observed in biological and subatomic particles, which are not revealed in the previous reports based on the quasi-stability theory. Quasi-stable size ratios are calculated from approximate equations of connected particles by using one-dimensional Taylor expansion in previous report, to explain regularity of size ratios appearing in various particles. In the present report, we evaluate the quasi-stable size ratios by performing multi-dimensional Taylor series of equation having two variables. The new quasi-stable size ratios can explain the size ratios seen in amino acids in detail. Moreover, size ratios seen in elements produced in cold fusion phenomenon could also be explained by using new quasi-stable size ratios. Thus, quasi-stable ratios from multi-dimensional Taylor series may show stronger evidence of the size ratios seen in various particles in nature.

ISBC OS1-3 Prognostic medication: for predicting recovery speed and degree of illness

Aya Hosoi, Ken Naitoh, Remi Konagaya, Keisuke Suzuki
(Waseda University, Japan)

A nonlinear differential equation model based on the bio-standard network theory, which explains interaction of six molecular cell groups on information and function in living beings, suggested the possibility for premonition when human beings become ill and whether or not human beings become ill. By utilizing the equations, two new patterns were found. In these patterns, it takes more generations of stem cell cycles to recover than normal illness reported in previous reports. Generations needed to recover can be thought as the degree of illness. Thus, new specific patterns may lead to predictions of recovery speed and degree of illness.

January 18 (Thursday), 09:00–10:30

ISBC OS1-4 Fundamental study on liquid-solid fuel system in combustion engines

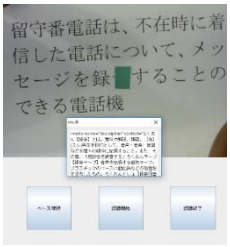
Yohei Naridomi, Ken Naitoh
(Waseda University, Japan)

In our laboratory, we have focused on a yeast and have studied the use of it for overcoming environmental problems in recent years. In case that we use the yeast as solid powder mixed in liquid fuel, we have to pulverize the yeast into nanoscale powder because there is possibility that the fuel injection device may be clogged. In this study, we pulverize the yeast and directly burn it by using a semiconductor laser (output 1.36 [W]). Then, we find that the yeast is burned even in the state where the oxygen concentration is low. In addition, we find that, according to decreasing the size of yeast, ignition delay becomes shorter.

ISBC OS1-5 Development of a reading support system with smart glasses

Minori Daikubara, Hideo Miyachi
(Tokyo City University, Japan)

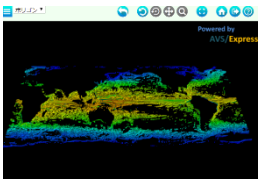
Wearable devices like smart glasses are going to be popular. Although those devices have the potential to support our life, there are still not many practical application systems. Then, we have started to develop a reading support system which shows the meaning the Kanji strings that the reader cannot understand. Using the proposed system, the user can see the information about the strings on smart glasses by just scanning the strings by his or her finger. In this paper, we present the prototype to realize the proposed system. It was able to show the feasibility and effectiveness of the proposed system, but it was not implemented with smart glasses.



ISBC OS1-6 Quality evaluation of the data reduction method by point rendering

Hideo Miyachi
(Tokyo City University, Japan)

I have been developing a data reduction method by representing 3D object as points. It was reported in AROB2016 on the title: Quality evaluation of 3D image represented by points. This paper is the follow-up report. Considering the condition at the point generation, I have learned that the light environment has an effect on quality degradation. By setting the specular effect to zero, I have solved the problem of the quality degradation that occurred in the previous report. The study was already reported in Journal of the Visualization Society of Japan (in Japanese) in 2016. This manuscript focuses on the part related to the image quality of the paper and details of it are written in English.



January 20 (Saturday), 09:00–10:00

Room F

ISBC OS2 Bridging a gap between pathogenic variant and disease phenotype for precision medicine

Chair: Soichi Ogishima (ToMMo, Tohoku University, Japan)

ISBC OS2-1 Standardization and utilization of pathogenic phenotypic data

Soichi Ogishima
(ToMMo, Tohoku University, Japan)

ISBC OS2-2 Standardization and utilization of pathogenic variant data

Toshiaki Katayama
(Database Center for Life Science, ROIS, Japan)

ISBC OS2-3 Integrated database of genomic and clinical information to promote precision medicine in Japan

Mayumi Kamada
(Kyoto University, Japan)

IThe improvement of genome sequencing technology enables us to apply clinical sequence using next generation sequencer on clinical diagnosis and treatment decision making. The purpose of clinical sequence is to provide an appropriate medical treatment policy based on individual genetic background. However, there is insufficient information to clinically interpret detected genomic variants, and it is one of factors that makes it difficult to realize practical clinical applications. Therefore, it is necessary to collect and associate genotype data and clinical phenotype information and share them.
In order to promote precision medicine in Japan, we have been constructing a disease-related genomic information database, named “MGeND (Medical Genomics Japan Database)”. The genomic variants and clinical data in Japanese population are collected from the fields of “cancer”, “rare disease”, “infectious disease”, “dementia”, “hearing loss”, and those are integrated into MGeND. In this talk, I would like to introduce our project and database.

ISBC OS2-4 PubCaseFinder: A diagnosis assistant system for rare diseases based on disease-phenotype annotations from published case reports

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At present, over 6,000 rare diseases have been identified, and it is estimated that up to 50% of patients with them never receive a diagnosis. Therefore, next-generation sequencing (NGS)-based diagnostics, which particularly employ whole-exome sequencing (WES), have been attempted for them. As a result, the diagnostic rate has been improved. However, processes for prioritization and interpretation of variants identified by WES are immature and time-consuming. Here, we present PubCaseFinder (https://pubcasefinder.dbcls.jp), a new diagnosis assistant system which employs a text mining-based approach. PubCaseFinder exploits disease-phenotype annotations extracted from more than one million case reports in PubMed in addition to those of annotations retrieved from Orphanet. We believe that the text mining-based approach proposed in this study shows a promising path for improving the diagnosis rate of NGS-based approaches.

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