ABSTRACTS

Plenary Speeches (Room G)

January 19 (Thursday), 10:55–11:45

Chair: Hiroshi Tanaka (Tokyo Medical & Dental University, Japan)

PL1 Modular Playware Technology

Henrik Hautop Lund
(Center for Playware, Technical University of Denmark, Denmark)

Playware is intelligent hardware and software that creates play and playful experiences for users of all ages. Such playware aim at providing play forces to bring the user into play dynamics, and in this way motivate the user to perform desired behaviors, e.g. for play, education, sports training, and health improvements. However, designing playware technology that results in specific behaviors of the user in not a trivial task, and it demands an array of background knowledge in a number of scientific fields. Indeed, definition of desired interactions and behaviors should arise from deep knowledge of the field of application (e.g. play of a specific user group, clinical knowledge of therapy of a specific patient group, professional music knowledge, and professional sport knowledge). In order to meet a practice, where several disciplines can join to develop such playware, we conceptualized the approach of modular playware in the form of building blocks. Building blocks should allow easy and fast expert-driven or user-driven development of playware applications for a given application field. The development of such modular playware technology takes its inspiration from modular robotics, human-robot interaction and embodied artificial intelligence. In this talk, I will present the design principles for creating such modular playware technology with focus on the play principles and educational principles that forms the foundation for the design principles of modular playware technology. I will exemplify the design principles with practical applications from the fields of play, education, sports, music, performance art, and health.

January 20 (Friday), 10:00–10:50

Chair: Ken Naitoh (Waseda University, Japan)

PL2 Fundamentals of Neurodynamics: Statistical neurodynamics and Neural Field Theory

Shun-ichi Amari
(RIKEN Brain Science Institute, Japan)

The brain consists of a vast number of neurons and processes information through their dynamical interactions. Peculiar characteristics neural networks would be useful for designing algorithms for artificial life and applying them to robot navigation. The present talk will focus on two types of neurodynamics, one is generalized majority decision dynamics and the other dynamics of excitation patterns in a neural field.
A neural network is a generalized majority decision system, in which each element calculates a weighted sum of the outputs of the other elements and decides its own output. Such a system is common in many biological systems such as a gene expression network, social communication network etc. We consider randomly connected binary elements and compare its dynamical behavior with that of a random Boolean logic network. We prove that a generalized majority decision system can make very quick decision (short transient time) compared with a random Boolean net. We also show that its state transition graph has a scale-free property so that a small number of states monopolize the incoming branches.
Neurons are arranged in a two-dimensional sheet in the cortex, where neighboring neurons are connected. Excitations in a neural field propagate and interact. We show an interesting phenomenon of traveling local excitations and their collision. Such phenomena will be applied to information processing having topology of the outer environment. This will be applied to the problem of robot navigation.

Invited Speeches (Room H)

January 19 (Thursday), 12:50–15:00

Chair: Peter S. Sapaty (National Academy of Sciences of Ukraine, Ukraine)

IS1   Future Technology and Market Developments for Unmanned Maritime Vehicles

Bob Nugent
(AMI International, USA)

The paper forecasts technological and market developments that will shape the future role and demand for unmanned maritime vehicles (UMV), to include unmanned underwater vehicles (UUV) and unmanned surface vehicles (UMV) over the next decade. We will begin with a review of the current UMV market by application/mission segment, technology and vehicle type, covering UUVs, both autonomous (AUV) and remotely operated (ROV), as well as USVs. Will then examine improvements in power and communications technologies that will change the UMV market in the coming decade and blur some of the current capability and design differences between commercial and military UMV markets. The paper will consider the thesis that improvements in UMV power and communications technologies will, following a trajectory seen in the UAV market, lead to growth in demand for UMVs in the civil, military and security sectors. These UMVs would be capable of augmenting manned platforms in conventional Anti-Surface, Anti-Submarine, and Anti-Air naval operations. However, AMI market and technical research suggests that the next decade of changing patterns of world economic and commercial maritime activity, and continuing technological limitations will limit the growth potential for weaponized UMVs. Rather, the period will see more demand among a broader customer base of commercial, security, and military users for hybrid UMVs optimized for port/harbor/facility security and environmental survey and exploration rather than combat missions. We will conclude with future UMV market forecast scenarios in a "high-medium-low" framework for both commercial and defense applications. These market scenarios predict significant increases in UMV sales and use, but temper some overly optimistic forecasts currently being made for these vehicles in both commercial and military/security sectors. The prospects of integration of scientific research and theoretical results in the robotics field (regularly publicized at the AROB symposia) with practical development and use of unmanned systems, especially in maritime domain, will be discussed too.

IS2   JAEA Robotics' Emergency Response to FUKUSHIMA-DAIICHI Accident

Shinji Kawatsuma
(Japan Atomic Energy Agency, Japan)

Japan Atomic Energy Agency (JAEA) developed Nuclear Emergency Response Robotics, two RESQ-A, a RESQ-B, a RESQ-C and a RaBOT, in 2001 after JCO criticality accidents occurred, and a Remote operated vehicle (ROV) for Glove Box dismantling cold test in 2008. It is very sorry that RESQ-A, RESQ-B and RESQ-C could not work because of lack of budget when the Fukushima-Daiichi accident occurred by a big earthquake and a huge Tsunami on March 11th 2011, that RaBOT was abandoned from the view point of Practicality, and that ROV could work but was in the facilities damaged by the earthquake. According to status and condition of the accident at Fukushima-Daiichi, JAEA have modified ROV and two RESQ-A to JAEA-1, JAEA-2 and JAEA-3, and prepared Robotics Control vehicles.
JAEA has provided Robotics and Robotics Control vehicle to TEPCO and is continuously supporting TEPCO for plant restoration. The summary and lesson learned of Robotics' emergency response to Fukushima-Daiichi accident, would be presented.

IS3   Using Robots to Understand Natural Behavior

Sanjay S. Joshi
(College of Engineering University of California, Davis, USA)

Since its beginnings, robotics has been inspired by animal and human behavior. However, more recently, roboticists and biologists have been using robots as new tools to better understand animal behavior itself. These new biorobots are not meant to look and move like real animals in all respects. Rather, they are designed to test specific biological hypotheses and lend insight into the complexity of natural behavior. In our lab, we are building artificial rat pups that have helped discover the factors responsible for the emergence of both individual and group rat pup behavior patterns. A central theme in this research is the emergence of behavior from the interaction of brain, body, and environment. In another project, we are building robotic squirrels to interact with live rattlesnakes, to study predator-prey interaction. These squirrel models have already helped discover the first-known infrared communication in the animal world. New versions of the robot are currently being used in natural environments to collect long-term information on squirrel and snake behavior. As robotics and biology researchers continue to work together, robotics tools will surely facilitate a deeper understanding of natural behavior.

January 21 (Saturday), 13:00–15:10

Chair: Ju-Jang Lee (KAIST, Korea)

IS4   Withstanding Asymmetric Situations in Distributed Dynamic Worlds

Peter S. Sapaty
(National Academy of Sciences of Ukraine, Ukraine)

In our modern dynamic world we are meeting numerous irregular situations where proper reaction could save lives and wealth and protect critical infrastructures. For example, no secret that world powerful armies with traditional system organizations are often losing to terrorists, insurgents or piracy with primitive gadgets but very flexible structures making them hard to detect and fight. And delayed reaction to earthquakes or tsunamis is a result of inadequacy of system organizations too. A novel philosophy and supporting high-level networking technology will be revealed that can quickly react on irregular situations and threats and organize any available human and technical resources into operable systems providing global awareness, pursuing global goals and self-recovering from damages. The approach allows us at runtime, on the fly, to formulate top semantics of the needed reaction on asymmetric events in a special Distributed Scenario Language (DSL), shifting most of traditional organizational routines to automated up to fully automatic implementation, with effective engagement of unmanned systems. This technology, based on gestalt and holistic principles rather than traditional multi-agent organizations will be revealed in detail, with numerous DSL scenarios that can be executed by any mixture of human and robotic components. These include runtime investigation and classification of irregular situations in distributed air, land and maritime environments, launching effective relief or combat missions like fighting collective manned piracy by smart unmanned swarms, and many others. The technology offered provides a unified solution to human-robot interaction and multi-robot behaviors just as a derivative of parallel and distributed interpretation of DSL.

IS5   Human Interface of Robots or Agents via Facial and Word Expression

Kaoru Sumi
(Future University Hakodate, Japan)

To design an intelligent interactive system, it is necessary to consider how humans feel about the system and establish a good relationship with them. In human robot interaction or human agent interaction, to establish a fifty-fifty relationship between a technical artifact (such as a robot or an agent system) and a human, the power of conviction or influence of the artifact over the human is very important.
To develop an intelligent system using a robot or an agent such as a system that proactively interacts with a user and even changes the user's intention according to the user's circumstances, our project investigated reactions with the user under several situations, considering human robot interaction and human agent interaction using facial and word expressions. Accordingly, we established some rules for making the agent's reaction favorable to the user on the basis of facial expressions and words, and gained some insights into the differences between human robot interaction and human agent interaction.
In this talk, I introduce the possibility of human persuasion by a robot or an agent using facial expressions and emotion words, based on the experimental results.

Invited Session on Playware (Room H)

January 20 (Friday), 11:10–12:40

Chair: Henrik Hautop Lund (Center for Playware, Technical University of Denmark, Denmark)

ISP1   MagicTiles. ALife for Real and Virtual RoboMusic

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

In this paper, we define and trace the contours of a new cross-modal and cross-media approach to robotic systems. In particular, our system is based on the use of electronic tiles and oriented to the use of ALife based interactive robotic modules that can be either virtual or real. This approach, which relies on interactive parallel and distributed processing algorithmics, can be thought and used on many different domains, though in the specific experience presented here, it has been applied to music composition and remix. In details, we describe the initial MagicTiles product prototype and show, as an example, a musical application with which any user can create and perform RoboMusic. We show how the combination of the Modular Interactive Tiles and the MagicTiles tools might lead to a broader vision of robotic systems with a fluid flow between the physical and virtual. Fluidity between the physical and virtual, enduser authoring, and ALife control is conceived to open up technology to ordinary users as a tool for creativity. Finally, in this paper, we attempt to explore the theoretical characteristics of such an approach and exploit the possible playware application fields.

IPS2   Social Playware for Supporting and Enhancing Social Interaction

Kenji Suzuki[1,2], Kazuki Iida[1], and Tomoya Shimokakimoto[1]
([1]University of Tsukuba, Japan)
([2]Japan Science and Technology Agency, Japan)

Social Playware is regarded as cyber-physical systems to support and enhance the experiences on play and social interaction among people by measuring and presenting physical contacts, spatial movement and facial expression. Several wearable or modular devices are used in this study, which enable behavior and affective measurements based on augmented human technology. It is aimed not only to integrate cyber and physical spaces by using developed wearable devices but also to show the possibility to help people develop their social ability throughout case studies.

ISP3   Adapting Body and Behaviour:
**   - learning and playing with a modular robotic platform -**

Patrizia Marti and Iolanda Iacono
(University of Siena, Italy)

The paper illustrates the design of Iromec, a robotic platform developed to engage disabled children in exploring play scenarios and thereby in learning through play. Key features of the system are: modularity, provided both at physical and functional level; configurability, to allow the teacher to make the physical and functional rearrangement of the robot configuration, construction to modify, enrich and adapt play activities to different and evolving needs of the disabled children. Furthermore the platform offers the possibility for the teacher/therapist to design new play scenarios addressing different educational objectives. The paper shows how the adopted design enables multiple robot configurations and play scenarios, and exemplifies the use of the robot in the school context.

ISP4   Adaptivity to Age, Gender, and Gaming Platform Topology in Physical Multi-Player Games

Davíð Þór Björnsson, Rafn Vídalín Friðriksson, Henrik Hautop Lund
(Center for Playware, Technical University of Denmark, Denmark)

In games where players are competing against each other, it can be of interest to ensure that all players are challenged according to their individual skills. In order to investigate such adaptivity to the individual player in physical multi-player games, we developed a game on modular interactive tiles which can be used in both single-player and multi-player mode. We implemented simple adaptivity methods and tested these with different user groups including children and adults of both genders. The results show statistically significant differences in the game interactions between children and adults, and between male and female players. Also, results show statistically significant differences in the game interactions between different physical set-ups of the modular interactive tiles, i.e. the interaction depended on the topology of the modular tiles set-up. Changing the physical set-up of the physical game platform changes the interaction and performance of the players.

Tutorial (Room H)

January 20 (Friday), 13:40–14:55

Introduction to silicon neuron and neuronal networks

Takashi Kohno
(University of Tokyo, Japan)

The silicon neuronal network is an electronic circuit system designed to mimic the biophysical functions in the nerve system, which is realized by interconnecting the silicon neurons and synapses, electronic counterparts to the neurons and the synapses. It has three major application fields; the hybrid system, the real-time neural network simulator, and the neuromorphic system. The hybrid system between the nerve system and the silicon neuronal networks have been playing crucial roles as neurophysiological research tools as well as are expected to realize novel biomedical devices. The neuromorphic system is expected to provide a robust, autonomous, and energy-efficient computation and controlling platform whose operating principle is similar to the nerve system.

Most of the silicon neurons are implemented using the Complementary Metal Oxide Semiconductor (CMOS) technology to simulate in real-time the activities of the membrane potential in neuronal cells. A wide variety of implementations have been tried in the aspect of their circuitry and the neuronal models they are based on. For the biomedical applications, a detailed ionic conductance neuron model has been implemented using ultra-low-power consuming circuitry, whereas more configurable models and circuitry with more precise operation were selected for the real-time simulators. Another most historical trend is to adopt an ultimately simplified model, the Leaky Integrate-and-Fire (LIF) model, to avoid difficulty of implementation and realize relatively large-scale network. Though it succeeded in the implementation aspect, the over-simplified model seemed to provide very few functionality. In these years, several efforts based on the nonlinear mathematics are made to find the silicon neuron models with sufficient dynamics that are feasible for implementation of large-scale silicon neuronal networks.

January 19 (Thursday), 08:45–10:15

Room A

GS3 Artificial life

Chair: Takaya Arita (Nagoya University, Japan)

GS3-1   Two-dimensional cellular automata model of microorganism morphosis

Takeshi Ishida
(Nippon Institute of Technology, Japan)

Living organism creates various shapes of the organ and the body by lamination of cells. An understanding of the generalized mechanism of biological morphosis is considered fundamental to applications in various fields, such as the mass-production of molecular machines in nanotechnology and artificial synthetics in biology. This study developed the model to simulate the morphogenetic mechanism of cells under the condition of two-dimensional cellular automata. Each cell is renewed by transition rules and the state of the next step was decided by the state of the cell and that of neighboring sites. The microbes such as protists create a variety of shapes by a single cell or a few cells. As trial simulation cases, we simulated the shape similar to various form of the microbe. Using our model, we confirmed that the variety of shapes was emerged with the slight changes of some parameters value.

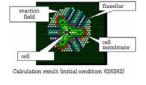#### GS3-2   Control of water flow to avoid twining of artificial seaweed

Jun Ogawa, Ikuo Suzuki, Masahito Yamamoto, and Masashi Furukawa
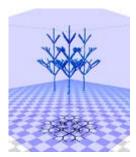(Hokkaido University, Japan)

This study presents a control method for a water flow to avoid seaweed twining in a cultivation pool. The water flow in the pool is modeled by the lattice Boltzmann method (LBM). Morphology of the seaweed is determined by L-system. Physics Modeling (PM) represents its physical model. Three physical properties, gradual collision, adhesiveness, and tear phenomenon for the seaweed are artificially introduced into simulation. Motion of the seaweed is examined in the virtual underwater pool by PM simulation. A water flow pattern is realized by controlling particles distributed in lattices. We ascertained that some water flow pattern can avoid the seaweed twining phenomenon by changing the water flow pattern in the simulation.

GS3-3   Dealing with rounding error problems in evolutionary physical simulation

Marcin L. Pilat, Reiji Suzuki, and Takaya Arita
(Nagoya University, Japan)

This paper introduces the problem of floating-point rounding errors in physical simulation. A simple virtual creature is simulated in a physical environment for a specified number of time steps. The effect of rounding errors is illustrated by varying the initial position of the creature which causes a change in the fitness value computed by a simple distance-based fitness function. With a large evaluation time, these rounding errors can produce significantly large differences in fitness. A discussion is provided on the importance of this finding for evolutionary simulations, including suggestions to alleviate the problem.

January 19 (Thursday), 08:45–10:15

GS3-4   Adaptive behavior to environmental changes: Emergence of multi-generational migration by artificial Monarch Butterfly

Katsuya Suetsugu, Atsuko Mutoh, Shohei Kato, and Hidenori Itoh
(Nagoya Institute of Technology, Japan)

The target of our study is the Monarch Butterfly, which is known for its multi-generational migration behavior: it migrates between southern Canada and Mexico over the course of one year within three to four generations. We approach this subject by using an evolutionary simulation that is an ecosystem consisting of artificial agents and five areas. We focus on the metamorphosis and the reproductive diapause, which are the ecological characteristics of the Monarch, and we design a model of agent which has the state as its inner parameter. We simulate under the environmental condition that the average annual temperature rises every year, which is modeled on the current global temperature rise. Our agents emerge the migration behavior similar to the multi-generational migration behavior of the actual Monarch. The migration process of the agents and their genetic factors are discussed, and our proposed model and the previous model are compared.

GS3-5   Real-time generation of prime sequence by one-dimensional cellular automaton with 8 states

Kunio Miyamoto[1] and Hiroshi Umeo[2]
([1]Japan Advanced Institute of Science and Technology, Japan)
([2]University of Osaka Electro-Communication, Japan)

In the present paper, we study a prime sequence generation problem on one-dimensional cellular automata. We show that an infinite prime sequence can be generated in real-time by a one-dimensional cellular automaton with 8 states. The algorithm that we propose is based on the well-known sieve of Eratosthenes, and its implementation is realized on an 8-state cellular automaton using 301 transition rules.

January 19 (Thursday), 08:45–10:15

Room B

GS8 Control techniques I

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

GS8-1   Attitude control of an airborne two wheeled robot

Huei Ee YAP and Shuji Hashimoto
(Waseda University, Japan)

The problem of balancing a two wheeled robotic platform has been intensively studied and well understood. However in such studies, the mathematical model of the robot is commonly derived under the assumption that the robot remains constant contact with the ground. This assumption limits the movement of the robot to continuous ground surface. In other words, any momentary airborne situation, such as traversing down a flight of stairs or falling off edges will render the control algorithm ineffective and cause the robot to fall upon landing. In this paper, the dynamics of a free falling two wheel robot are investigated and a novel attitude control scheme is proposed. We proposed using the wheel of the pendulum as a reaction wheel to provide control torque for correcting the robot's attitude in air and ensure safe landing. The effectiveness of the proposed approach is demonstrated through both simulations and actual implementation.

GS8-2   A new adaptive and flexible communication protocol for long-term operation of ubiquitous sensor networks with multiple sinks and multiple sources
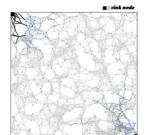
Satoshi Yasuda, Akihide Utani, and Hisao Yamamoto
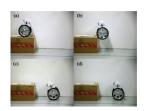(Tokyo City University, Japan)

There is growing expectation for a wireless sensor network. A wireless sensor network has great potential as a means of realizing a wide range of applications, such as natural environmental monitoring and environmental control in residential spaces or plants. To facilitate a ubiquitous environment by a wireless sensor network, however, its control mechanism should be adapted to the variety of types of communication, i.e., one-to-one, one-to-many, many-to-one, and many-to-many, depending on application requirements and the context. This paper proposes a new adaptive communication protocol for the long-term operation of such a ubiquitous sensor network. We evaluate the proposed protocol using computer simulation experiments and discuss its development potential.
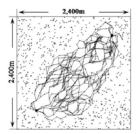
GS8-3   Data gathering scheme for area monitoring-based wireless sensor networks

Kosuke Ikeda, Akihide Utani, and Hisao Yamamoto
(Tokyo City University, Japan)

Wireless sensor networks have great potential as a means of realizing a wide range of applications, such as natural environmental monitoring, environmental control in residential spaces or plants, and object tracking. As a frame to actualize these sensor applications, this study assumes a monitoring-oriented wireless sensor network, which periodically gathers their sensing data from all sensors placed in a service area. This paper proposes an autonomous decentralized control scheme with data aggregation technique to prolong the lifetime of monitoring-oriented wireless sensor networks. This is a novel scheme devised by considering the application environment of a wireless sensor network as a typical example of a complex system where the adaptive adjustment of the entire system is realized from the local interactions of components of the system. We evaluate our scheme using simulation experiments, and also discuss its development potential.

GS8-4   A centralized control system for ecological vehicle platooning using linear quadratic regulator theory

Anan Kaku, Masakazu Mukai, and Taketoshi Kawabe
(Kyushu University, Japan)

This paper presents an ecological vehicle platooning control system that aims in reducing overall fuel consumption of the vehicles in a platoon. A centralized linear quadratic regulator system for controlling the vehicles in the platoon has been developed considering the aerodynamic characteristics of the vehicle and the resistance due to the road slope. The proposed control system is simulated on a highway with up-down slopes for high speed driving. Its fuel saving performance is compared with a conventional decentralized vehicle platooning control system. Computer simulation results reveal the significant improvement in fuel economy by the proposed control system.

GS8-5   A feedback-trained robot task assignment system

Jeremy Straub and Eunjin Kim
(University of North Dakota, USA)

Task assignment to a collection of heterogeneous robots is an ill posed problem that also presents the complexity of continuous change. The experiment described mirrors a variety of real-life conditions where alternate sensor types may be required to complete a task. Robots begin by searching for targets of interest and return to this when not assigned an alternate task. When a target is found the robot determines whether it is able to adequately assess it and then either issues a request for confirmation of its assessment or a request for an alternately equipped robot to be sent. A central planner that runs on an arbitrarily selected robot receives all requests and tasks a robot based on a combination of existing task-load, closeness to the target and closeness of task fit. The assigned robot receives the task and incorporates it into its task list based on path optimization.

GS8-6   A Control Method to Suppress the Rotational Oscillation of a Magnetic Levitating System

Toshimasa Nishino[1], Yasuhiro Fujitani[2], Norihiko Kato[2], Naoaki Tsuda[3],
Yoshihiko Nomura[2], and Hirokazu Matsui[2]
([1]Toshiba industrial products manufacturing corporation, Japan)
([2]Mie University, Japan)
([3]Wakayama National College of Technology, Japan)

A magnetic levitation technique has a potential to realize a non-contact object manipulation. As a result, it is expected that a lot of problems caused by contacts can be evaded. Then, the authors developed a magnetic levitation system that was able to manipulate a magnetically levitated hand by non-contact. In this system, four electromagnets are assigned on a horizontal plane for 3-D positioning of the hand. However, it had been examined only about the movement of three directions so far.
In this paper, a new controller was presented which was developed to suppress the rotation around z axis, and its effectiveness was conformed through magnetic levitating experiments.

January 19 (Thursday), 08:45–10:15

Room C

GS10 Data mining I

Chair: Daisuke Yamaguchi (Toin University of Yokohama, Japan)

GS10-1   Web search support system for the smartphone using call and Web logs

Takuya Ito and Hiroyuki Nishiyama
(Tokyo University of Science, Japan)

In recent years, Web searching on mobile devices with a touchscreen has increased. However, a search query using a mobile phone is not easy as that using a PC. In this study, we propose a search support system that provides user search queries and Web pages to suit the user's situation. This system continually records the user's location, time, Web search log and call log. Since the system does not have a server, the user's mobile phone records everything and provides search assistance to the users based on the recorded information.

GS10-2   Sentiment analysis for domain-specific texts

Hidekazu Yanagimoto and Michifumi Yoshioka
(Osaka Prefecture University, Japan)

We develop a sentiment analysis system for domain-specific texts. The sentiment analysis estimates a polarity of a text, for example positive or negative. To develop such a system a dictionary, which consists of words and their polarities, is needed. The dictionary reflects specialists' knowledge and affects a sentiment analysis precision. Hence, it is important to construct an appropriate dictionary. And making a dictionary needs much human cost generally. As a good dictionary is constructed, the human cost must be decreased. To achieve the goal our proposed approach uses a bootstrap method to decrease human cost and a chi-square statistic to estimate a polarity of a word correctly. To evaluate a performance of the proposed approach we carried out an evaluation experiment using real stock market news, T&C news. We confirmed that the proposed approach could construct a dictionary but had some problems which were inappropriate words and that the dictionary did not have enough words.

GS10-3   A localization method for smart phones by detection of walking using an accelerometer in indoor environments

Kunioki Hayashi and Hiroyuki Nishiyama
(Tokyo University of Science, Japan)

This paper proposes a new localization method for smart phones using an accelerometer. Although the global positioning system (GPS) is applied in various fields, it has a disadvantage in that it cannot be used effectively in indoor environments. To overcome this problem, many localization methods in indoor environments exploiting Wireless LANs have been proposed, but few systems achieve high accuracy. On the other hand, the smart phones with many sensors and powerful CPUs are becoming wide spread. We examined a localization method specialized for smart phones, and evaluated our proposed method by implementing a prototype system and conducting experiments with it.

GS10-4   Batch fast update algorithm for incremental association rule discovery

Araya Ariya and Worapoj Kreesuradej
(King Mongkut's Institute of Technology Ladkrabang, Thailand)

When new transactions are inserted into an original database, the existing rules may be change. An incremental association rule mining is an approach to deal with such problem. This paper proposes an algorithm for mining incremental association rules, called batch fast update (BFUP). The proposed algorithm improves the performance of FUP algorithm by reducing a number of scanning times of an original database. The experimental results show that an execution time of BFUP is much faster than that of FUP.

Room D

GS25 Robotics I

Chair: Jiwu Wang (Beijing Jiaotong University, P. R. China)

GS25-1   Development of MEMS micro robot using piezoelectric actuator mechanism
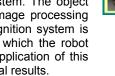
Tatsuya Ogiwara, Kazuto Okazaki, Yutaro Kezuka, Shinpei Yamasaki,
Minami Takato, Ken Saito, and Fumio Uchikoba
(Nihon University, Japan)

This paper presents the MEMS (Micro Electro Mechanical Systems) micro robot using piezoelectric actuator mechanisms. The size of the fabricated micro robot was 3.8, 4.0, 3.5mm, width, length and height, respectively. The basic components of the MEMS micro robot were made from silicon wafer. The micro fabrication of the silicon wafer was done by the MEMS technology. The vibration of the piezoelectric elements was transduced to rotational movement by the piezoelectric actuator mechanisms. Link mechanisms generated the locomotion of the robot from rotational movement. In this paper, continuous movement was achieved by using the piezoelectric actuator mechanism without thermal activation.

GS25-2   Development of an autonomous-drive personal robot "An environment recognition and the position detecting system that used image processing and an LRS"

Katsuhiro Yamamoto, Hideki Ishimaru, and Eiji Hayashi
(Kyushu Institute of Technology, Japan)

We are developing an autonomous personal robot that will be able to perform practical tasks in a human environment based on information derived from camera images and a laser range sensor(LRS). It is very important that the robot be able to move autonomously in a human environment, and to select a specific target object from among many objects, and these functions will be possible in our system. The robot's environmental recognition system is composed of an autonomous driving system and an object recognition system. First, the autonomous driving system calculates the driving route from the visual information provided by a CCD camera. The robot is driven by this system. The object recognition system proceeds by identifying the specified object using image processing and an LRS, and the robot can grasp the object. An environment recognition system is essential to both of these functions. Here we explain the algorithm by which the robot recognizes the surrounding environment. In addition, we describe the application of this system to our robot, evaluate its performance and discuss our experimental results.

January 19 (Thursday), 08:45–10:15

GS25-3　Design of robotic behavior that imitates animal consciousness: Construction of the user-recognition system

Motoki Yoshida, Kei Ueyama, and Eiji Hayashi
(Kyushu Institute of Technology, Japan)

Our research has been focused on developing a robot with "consciousness" like people or an animal to enhance the user affinity of service robots. Our laboratory previously conceived a model of the mechanism of consciousness and action and a software architecture based on this model that can be used to con¬trol the action of a robot, called the Consciousness-Based Architecture (CBA). Here, we built on this model both theoretically and practically. First, we newly theorized a "motivation model" which assumes that certain motives inhere in the actions of sentient beings, and that the motivational processes involved could become part of the robot's determination of action. Our motivation model is based on the dopamine-generating mechanism of sentient beings. Then, as a practical step toward developing an emotionally interactive robot, we developed a user-recognition system using a CCD camera.

GS25-4　An abductive environment enables teacher's intervention in a robotics class

Ilkka Jormanainen[1], Meurig Beynon[2], and Erkki Sutinen[1]
([1]University of Eastern Finland, Finland)
([2]University of Warwick, UK)

We propose a novel approach to support teacher's work in an unpredictable learning environment, such as a robotics class. The Conflative Learning Environment (CLE) approach blends the roles of the student, the teacher, and the software developer by taking the diverse users of the learning environments beyond their traditional, fixed roles and blending the users' activities and working environments with each other. We report results from a qualitative study indicating that a novel monitoring environment developed by following the CLE approach helped teachers to recognize students' particular problems better than when observing the students without such support. Results of the study have been used to guide us in the further development of the CLE approach and the monitoring environment.

GS25-5　A simplified approach towards realizing a three dimensional fax based on claytronics

Chetan J and Shrikrishna Upadhyaya
(BMS Institute of technology, India)

In this paper we describe a model approach to realize a three dimensional copy of an object with the help of claytronics. Claytronics is a form of programmable matter that takes the concept of modular robots to a new extreme. Programmable matter refers to a technology that will allow one to control and manipulate three-dimensional physical artifacts (similar to how we already control and manipulate two-dimensional images with computer graphics). In other words, programmable matter will allow us to take a big step beyond virtual reality, to synthetic reality, an environment in which all the objects in a user's environment (including the ones inserted by the computer) are physically realized.
　Here we discuss a way to realize a 3D facsimile starting with image/shape acquisition continuing with transmission and finally the process completing with the 3D realization of the target object. We describe the process of image/shape acquisition with two separate methods where the selection of the method is purely dependent on the object. Transmission can be achieved by conventional means. For the object realization we describe an algorithm which can fulfill the purpose.
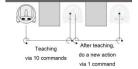
Room E

GS26 Robotics II

Chair: Nobuhiro Okada (Kyushu University, Japan)

GS26-1 A method of teaching a new action to a communication robot through spoken commands

Eiichi Inohira[1] and Yudai Okuda[2]
([1]Kyushu Institute of Technology, Japan)
([2]Hoshiden Kyushu Corporation, Japan)

We study on an approach to teach a new action to a communication in spoken commands. It is supposed that these robots are used for household use. Usually, a spoken command corresponds to a predefined action in this type of system. However, it is difficult to prepare many predefined actions to meet user's expectations in any situations. In this paper, we proposed an approach to teaching a new action which is composed of basic actions through spoken commands. And also, we demonstrated our proposed approach through a communication robot PaPeRo, which has a speech recognition system in Japanese. In our experiment, it took approximately 50 seconds to instruct the five combinations of a basic action and an instruction modifier through 10 spoken words. After the new action is thought, it took approximately 20 seconds to complete a series of stored actions through a single spoken word.

GS26-2 Evaluation of the teleoperation system based on force-free control and visual servo control by using different human operator perception: evidence verified by experiments and statistical analysis

Achala Pallegedara[1], Yoshitaka Matsuda[1], Naruto Egashira[2], Takeo Matsumoto[1], Kenta Tsukamoto[1], Takenao Sugi[1], and Satoru Goto[1]
([1]Saga University, Japan)
([2]Kurume National College of Technology, Japan)

This research considers the teleoperation of an articulated robot arm by means of force-free control and visual servo control over communication channels using Internet technology. The main investigation is carried out to find how effectively improves the accuracy and the effectiveness of the teleoperation after provision of a visual feed back channel to the system. The system accuracy, effectiveness, repeatability, and handleability based on the human operator's skills and operator's cognitive aspects are evaluated by using statistical data analysis and experimental results. Effectiveness of the statistical analysis is assured by increasing number of experiment data and assuming environmental factors and implicit variables maintain to be unchanged.

January 19 (Thursday), 08:45–10:15

GS26-3   Development of flexible joints for a humanoid robot that walks on an oscillating plane

Takehiro Yoneyama and Kazuyuki Ito
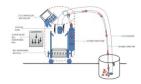(Hosei University, Japan)

In this study, we develop flexible joints for a humanoid robot that walks on an oscillating plane and discuss their effectiveness in compensating disturbances. Conventional robots have a rigid frame and are composed of rigid joints driven by geared motors. Therefore, disturbances, which may be caused by external forces from other robots, obstacles, vibration and oscillation of the surface upon which the robot is walking, and so on, are transmitted directly to the robot body, causing the robot to fall. To address this problem, we focus on a flexible mechanism. We develop flexible joints and incorporate them in the waist of a humanoid robot; the experimental task of the robot is to walk on a horizontally oscillating plane until it reaches the desired position. The robot with the proposed flexible joints, reached the goal position despite the fact that the controller was the same as that used for a conventional robot walking on a static plane. From these results, we conclude that our proposed mechanism is effective for humanoid robots that walk on an oscillating plane.

GS26-4   Manually controlled manhole cleaning robotic system

Gopal Joshi, Animesh Rana, and Venkateshwar R
(Vels University, India)

Aimed at tackling the disadvantages of conventional manhole a new manually controlled manhole cleaning robot system is proposed for performing cleaning work instead of human cleaning manholes that is characteristic of low safety, low efficiency, long time and environmental pollution problems. The robotic system consists of manually controlled suction pump, hydraulic pump station, probe controller, LCD screen for monitoring; windlass, biodegradable bags, disinfectant sprayer. The modular structures have been adopted in the robotic system, which makes it possible to assemble all subsystems in a single unit. This robotic system can reduce the complex mechanism for cleaning the manholes and even provide environmental friendly way of disposing the sludge.

The Seventeenth International Symposium on Artificial Life and Robotics 2012 (AROB 17th '12),
B-Con Plaza, Beppu, Oita, Japan, January 19-21, 2012

January 19 (Thursday), 08:45–10:15

Room F

OS18 Intelligent control & Modeling

Chair: Huailin Zhao (Shanghai Institute of Technology, P. R. China)
Co-Chair: Fengzhi Dai (Tianjin University of Science and Technology, P. R. China)
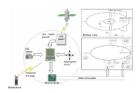
OS18-1　System development of an artificial assistant suit

Jianling Bian[1], Huailin Zhao[2], Xiaomin Liu[3], and Masanori Sugisaka[4]
([1]Zhengzhou University, P. R. China)
([2]Shanghai Institute of Technology, P. R. China)
([3]North China University of Water Resources and Electric Power, P. R. China)
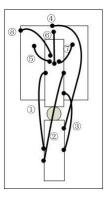([4]Nippon Bunri University, Japan)

The artificial assistant suit is a kind of assistant suit which can be put on the human upper body and help the actions of human's two arms. It is actuated by Mckibben pneumatic artificial muscles (simply call it Mckibben muscles later). This paper introduces the whole system and its structure. The configuration of the Mckibben muscles is discussed. The measurement and control system is introduced in detail. The electropneumatic valve's characteristics are analyzed. The detection of the motion intention of human arms by SEMG signals is discussed too.

OS18-2　Fundamental research on the fuzzy control to the autonomous airship

Long Li[1], Yuan Li[1], Fengzhi Dai[1], Dejin Wang[1], and Yutaka Fujihara[2]
([1]Tianjin University of Science and Technology, P. R. China)
([2]Matsue College of Technology, Japan)

The fuzzy control to the experimental autonomous airship is introduced in this paper. The fundamental development and research on the hardware and the program to control the airship navigating along the shortest flight path to the target point is executed. The fuzzy control is used because the airship system is nonlinear and it is difficult to describe the accurate motion equations of the system. At last, to compare the efficiency, the traditional PD control is also applied. The result of comparison shows the validity of the fuzzy control.
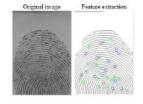
January 19 (Thursday), 08:45–10:15

OS18-3   Fundamental research on the fingerprint recognition algorithm

Binyao Li[1], Fengzhi Dai[1], Dejin Wang[1], Baolong Zhang[1], and Naoki Kushida[2]
([1]Tianjin University of Science and Technology, P. R. China)
([2]Oshima National College of Maritime Technology, Japan)

With the further need for security, the fingerprint pattern recognition technology began to be used in various fields, from the theoretical field to practice. Digital fingerprint processing concerns the algorithms and processes of automated fingerprint image processing, feature measurement, detail description, pattern analysis, recognition and classification by the computer instead of manual. In this article, four modules for fingerprint identification are introduced: the modules for fingerprint image sampling, for image pre-processing algorithm, for feature extraction and for feature matching algorithm. Finally this article gives the completed procedure of the fingerprint image processing and feature extraction.

OS18-4   Configuration of the Mckibben Muscles and action intention detection for the artificial assistant suit

Xiaoqing Jia[1,2], Huailin Zhao[1], Lixia Wang[1], and Masanori Sugisaka[3]
([1]Shanghai Institute of Technology, P. R. China)
([2]Shanghai Maritime University, P. R. China)
([3]Nippon Bunri University, Japan)

The artificial assistant suit is a kind of assistant equipment, which is actuated by Mckibben muscles and can be put on the human upper body, to help the upper limb act. It can detect the action intention of human's upper limb automatically and output definite force complying with the intention. The configuration of the Mckibben muscles is introduced in detail. How to detect the action intention by the surface electromyography signal is discussed deeply. The related experiments and their results are given.

January 19 (Thursday), 12:50–15:00
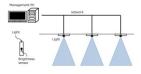
Room A

GS2 Artificial intelligence

Chair: Hirokazu Taki (Wakayama University, Japan)

GS2-1   Power saving parameter learning for light power control in public space

Hiroaki Obana, Hirokazu Miura, Noriyuki Matsuda, Hirozumi Kaneko, Fumitaka Uchio, and Hirokazu Taki
(Wakayama University, Japan)

This paper describes a parameter learning system for light energy saving control. It is very important to control the light system efficiently because the large electric energy consumer is the light system. In the home light control, so far, the brightness sensor system which controls each light has been developed. However it controls each light independently, the multiple light control system doesn't work well. There are a lot of lights in even a single room of the office or the school. Furthermore, user requirements for lighting intensity are different according to user locations in the room. Therefore, in order to control each light properly, we must calculate optimal brightness pattern quickly. In this study, we propose the lighting system to determine the brightness of the lighting system using genetic algorithms in public spaces. This system solves the trade-off between the user satisfaction and the energy saving.

January 19 (Thursday), 12:50-15:00

GS2-2   Control of flock behavior by using tau-margin -Obstacle avoidance and reformation-

Tatsuya Kon[1], Akira Yokokawa[2], and Kazuyuki Ito[1]
([1]Hosei University, Japan)
([2]SANYO Electric Co.,Ltd., Japan)

In this paper, we address the control of flock behavior using the time to contact called the tau-margin. Recently, swarm intelligence has attracted considerable attention, and it has been applied to control various agents. The Boid theory proposed by Craig Reynolds (1987) is one such application. In ecological psychology, it is considered that animals perceive the time to contact with an object, instead of the distance to the object. In this study, we developed a simulator that simulates the dynamics of mobile agents and their visual system. We embedded modified Boid rules in which the tau-margin is considered instead of the distance. Our simulation results show the realization of flock behavior. In addition, we observe separation to avoid obstacles and reformation to pass through a narrow space.

GS2-3   A proposition of adaptive state space partition in reinforcement learning with Voronoi Tessellation

Kathy Thi Aung and Takayasu Fuchida
(Kagoshima University, Japan)

This paper presents a new adaptive segmentation of continuous state space based on vector quantization algorithm such as LBG (Linde-Buzo-Gray) for high-dimensional continuous state spaces. The objective of adaptive state space partitioning is to develop the efficiency of learning reward values with an accumulation of state transition vector (STV) in a single-agent environment. We constructed our single-agent model in continuous state and discrete actions spaces using Q-learning function. Moreover, the study of the resulting state space partition reveals in a Voronoi tessellation. In addition, the experimental results show that this proposed method can partition the continuous state space appropriately into Voronoi regions according to not only the number of actions, and achieve a good performance of reward based learning tasks compared with other approaches such as square partition lattice.

GS2-4   Universal Creativity Engine: Real-time creation of melody and lyrics based on the Ant system
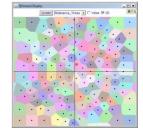
Kenta Nishio and Takaya Arita
(Nagoya University, Japan)

Creativity plays an important role in almost all human activities and has been investigated by many researchers in a wide variety of fields. However, it is difficult to design a methodology for generating highly creative artifacts mainly because previous researches tended to depend a little too much on human subjective evaluation. One idea to tackle with creativity is to leave out the value aspect from the definition of creativity for the moment at least. This paper proposes Universal Creativity Engine (UCE), a conceptual organization for reproducing the creative process in human brain on the basis of the idea. It is characterized by a real-time property, representation universality and creativity based on two types of deviation. This paper also describes the design of UCE-ANT, the initial prototype implementation of UCE, for creation of melody and Lyrics based on the Ant system.

January 19 (Thursday), 12:50–15:00

GS2-5   Simple system for detecting sound localization based on the biological auditory system

Takanori Tomibe and Kimihiro Nishio
(Tsuyama National College of Technology, Japan)

In this study, we proposed and fabricated the simple system for detecting sound localization based on the biological auditory system. The proposed system is constructed with the simple circuit for detecting sound localization, two microphones, the photodiode, the motor and the rotation table. The test system was fabricated by the simple circuit for detecting sound localization by using the simple circuit constructed with discrete metal oxide semiconductor (MOS) transistors on the breadboard. The experimental results of the test system showed that the proposed system can detect the position of the sound of the target. We can realize novel target tracking system by applying the proposed system based on the biological auditory system.

Room B

GS9 Control techniques II

Chair: Kohji Higuchi (The University of Electro-Communications, Japan)

GS9-1   Fuzzy servo control of an inverted pendulum system

Mohd Khairi Bin Mohamed Nor, and Shigenori Okubo
(Yamagata University, Japan)

The studies of model based fuzzy control system are concentrating on regulator problem. But in real system, the output of the system needs to be regulated to the desired reference output which is not only zero. Servo system can regulate the output to desired reference output without steady state error against unknown disturbance. In this paper, application of fuzzy servo control for stabilizing inverted pendulum system will be discussed. The inverted pendulum system is a simple system consists of pendulum and cart but has strong nonlinearity and inherent instability. The simulations are done and the result shows that the proposed method can stabilize the system.

D: Small domain area
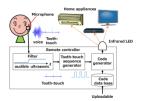Ω: All domain   P: Driving point

GS9-2   A lightweight sensing method of tooth-touch sound for disabled person using remote controller
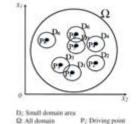
Akira Yamawaki and Seiichi Serikawa
(Kyushu Institute of Technology, Japan)

To support disabled people using remote controllers, biological signals have been applied to. We propose a lightweight sensing method extracting the tooth-touch without a sophisticated signal processing to eliminate the normal audio sound. Proposal uses a shock wave (i.e. ultrasonic wave) which is generated when the upper and lower tooth hit each other, instead of the sound wave of tooth-touch. By our method, the signal processing has only to perform a high-pass filter eliminating lower frequency domain than the ultrasonic domain. Through the preliminary experiment with a conventional microphone, we show that the tooth-touch has the larger power than the voice sounds in the ultrasonic region. Then, we design the filtering hardware to implement a small and cheap SoC. Through the implementation to the FPGA, and the simulation, we show that our hardware is small and has the enough performance for a real-time operation.

GS9-3   Two-dimensional merging path generation using model predictive control

Wenjing Cao, Masakazu Mukai, and Taketoshi Kawabe
(Kyushu University, Japan)

In this research, the merging problem is considered in the two-dimensional space instead of the one-dimensional space. In this paper, we set up the mathematic model of the system, formulate the two-dimensional merging problem as an optimization problem and solve it by model predictive control (MPC). To compare the simulation results with the practical situation, three typical cases were researched. In order to be more practical, the initial conditions of the cases were set according to the data obtained through analyzing the helicopter-shot video. The results represent that the MPC-controlled merging maneuver carried out safely and smoothly, and the relative positions after merging is also the same with the practical results in all the three representative conditions considered in this research. The absolute values of the accelerations of the vehicles are all below 3m/s^2, which are quite practical as well. …

GS9-4   Model predictive control of a power-split hybrid electric vehicle system

Kaijiang Yu, Masakazu Mukai, and Taketoshi Kawabe
(Kyushu University, Japan)

This paper presents a model predictive control (MPC) approach for the energy management problem of a power-split hybrid electric vehicle (HEV) system. The MPC is suggested to optimally share the road load to the engine and the battery. By analyzing the configuration of the power-split HEV system, we developed a simplified model for better implementation of MPC. The MPC problem is solved using numerical computation method: continuation and generalized minimum residual (C/GMRES) method. The computer simulation results showed that the fuel economy was improved using the MPC approach than the ADVISOR rule based approach over three driving cycles respectively. We conclude that the MPC approach is effective for the application of power-split HEV systems energy management and has the potential for real-time implementation. The simplified modeling method of the power-split HEV system configuration can be applied to other configurations of HEV.

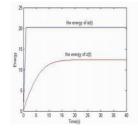## January 19 (Thursday), 15:20–16:20

Room A

OS17 Intelligent control

Chair: Yingmin Jia (Beihang University, P. R. China)
Co-Chair: Junping Du (Beijing University of Posts and Telecommunications, P. R. China)

OS17-1　H_∞ consensus control for high-order multi-agent systems with disturbances

Ping Wang[1], Yingmin Jia[1], Junping Du[2], and Fashan Yu[3]
([1]Beihang University, P. R. China)
([2]Beijing University of Posts and Telecommunications, P. R. China)
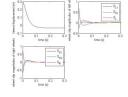([3]Henan Polytechnic University, P. R. China)

This paper is devoted to consensus problems in directed networks of high-order agents with disturbances. A new distributed protocol is proposed with the consideration of model uncertainty, which only depends on the agent's own information and it's neighbors' first state, an auxiliary variable is included to describe the effects of all-order derivatives' relative information. Based on Lyapunov theory, for three cases: (a) network with fixed topology and zero time-delay; (b) network with switching topology and zero time-delay; (c) network with fixed topology and non-zero time-delay, sufficient conditions are derived correspondingly to make all agents reach H_∞ consensus. Especially, the approach used in this paper does not need any model transformation. Finally, numerical simulations are provided to show the effectiveness of the obtained results.

OS17-2　Lane keeping control for 4WS4WD vehicles subject to wheel slip constraint

Changfang Chen[1], Yingmin Jia[1], Junping Du[2], and Fashan Yu[3]
([1]Beihang University, P. R. China)
([2]Beijing University of Posts and Telecommunications, P. R. China)
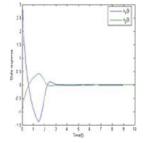([3]Henan Polytechnic University, P. R. China)

This paper proposes a lane keeping control scheme that prevents an autonomous 4WS4WD vehicle from wheel skidding in presence of road curvature and aerodynamic drag. The control objectives can be specified as various closed-loop specifications, such as lane departure avoidance, wheel slip constraint and disturbance attenuation. An LMI approach is used to deal with these objectives simultaneously, which combines the quadratic stabilization technique with constraints on inputs. Simulations show that the proposed controller effectively limits the combined wheel slip and improves lane keeping performance.

OS17-3　Robust exponential stabilization criteria for uncertain linear systems with interval time-varying delay

Nan Xiao[1], Yingmin Jia[1], Junping Du[2], and Fashan Yu[3]
([1]Beihang University(BUAA), P. R. China)
([2]Beijing University of Posts and Telecommunications, P. R. China)
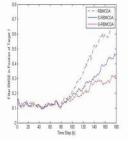([3]Henan Polytechnic University, P. R. China)

In this paper, we study the problem of robust exponential stabilization for uncertain linear systems with interval time-varying delay. We first rewrite the original system into a new form, then by dividing the delay intervals into two equal subintervals, we construct the Lyapunov-Krasovskii functional with augmented vectors. By appropriate enlarging some terms that appeared in the derivative of the Lyapunov-Krasovskii functional and using a new lower bounds lemma, delay-dependent robust exponential stabilization criteria are obtained based on Lyapunov stability theory and free weighting matrix technic. For getting the design of controller, we fix some formations of the introduced free-weighting matrices with given parameters, thus the obtained criteria are in terms of Linear Matrix Inequalities(LMIs). Finally numerical examples are given to show the effectiveness and less conservativeness of the proposed method.

January 19 (Thursday), 15:20–16:20

OS17-4   Improved Rao-Blackwellized particle filtering algorithms for multi-target tracking in clutter

Yazhao Wang[1], Yingmin Jia[1], Junping Du[2], and Fashan Yu[3]
([1]Beihang University, P. R. China)
([2]Beijing University of Posts and Telecommunications, P. R. China)
([3]Henan Polytechnic University, P. R. China)

We consider the problem of multiple target tracking in the presence of clutter (false alarm) measurements. To improve the performance of the Rao-Blackwellized particle filter (RBPF) data association algorithms, some simple but effective strategies are implemented. We first present a sequential likelihood method, i.e., all measurements are used to update the particles more than one time in each time step. It is observed that the tracking performance of the algorithm is not severely loss with fewer particles. We then present a simple gating technique to reduce the validated measurements to a feasible level. It is worth mentioning that the association probabilities are not calculated by grouping targets into clusters as the joint probabilistic data association (JPDA), but only reserve the validated measurements in the joint validation region (gate) and ignore the measurements outside. Simulations are also presented to compare the performance of the proposed algorithms.
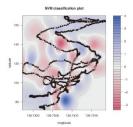
Room B

OS28 Systems for defense of disaster

Chair: Masao Kubo (National Defense Academy of Japan, Japan)
Co-Chair: Hiroshi Sato (National Defense Academy of Japan, Japan)

OS28-1   Estimation of Hazardous Area with Surveillance UAV

Hiroshi Sato, Masao Kubo, and Akira Namatame
(National Defense Academy of Japan, Japan)

Unmanned Aerial Vehicle (UAV) is becoming useful tool for the surveillance of the area where man can't go in. Autonomous flying UAV can use large amount of data for posture control and navigation during its flight. This paper proposes the method which recycle these data for the purpose of environment recognition. In order to achieve this, we adopt machine learning techniques. Support Vector Machine (SVM) is chosen because it is faster and lighter than other machine learning technique. We demonstrate the method using the UAV made by Hitachi Ltd. and Kawada Industries, Inc. It can fly autonomously using GPS, motion sensor, magnetic sensor. From the flight log obtained by these sensors, SVM can not only classify the space into safe and dangerous area, but also predict undiscovered dangerous area. These areas coincident with the impression of operator who flied the radio control airplane in the same airspace.

January 19 (Thursday), 15:20–16:20

OS28-2   Safety of ships evacuation from Tsunami
-Survey Unit about the Great East Japan Earthquake-

Saori Iwanaga and Yoshinori Matsuura
(Japan Coast Guard Academy, Japan)

The Great East Japan Earthquake occurred at 14:46 on Friday, 11 March 2011. It was the most powerful known earthquake to have hit Japan, and one of the five most powerful earthquakes in the world overall since modern record-keeping began in 1900. The earthquake triggered extremely destructive tsunami waves of up to 40.5 meters in Miyako, Iwate. Over 20,000 people dead and the missed. International Research Center for Marine Policy is think tank of Japan Coast Guard and is belong to Japan Coast Guard Academy. Research unit was organized to survey and research of The Great East Japan Earthquake in particular about ocean. This unit collects the information about it and analyzes and synthesizes collected information from a professional viewpoint respectively. Then, the unit study about damage by TSUNAMI, damage of ships, urgent refuge and search rescue to pick new actual explication and various lessons out.

OS28-3   Individual recognition-free target enclosure model

Masao Kubo[1], Tatsurou Yoshimura[1], Akihiro Yamaguchi[2], and Hiroshi Sato[1]
([1] National Defense Academy of Japan, Japan)
([2]Fukuoka Institute of Technology, Japan)

Target enclosure by autonomous robots is useful for many practical applications, for example, surveillance of disaster sites. Scalability is important for autonomous robots because a larger group is more robust against breakdown, accidents, and failure. However, it is more difficult to operate a larger group of robots because their individual capacity for recognizing team-mates should be higher. In this paper, to achieve a highly scalable target enclosure model, we demonstrate a new condition for Takayama's enclosure model. The original model requires a static relationship between agents. However, robots can form an enclosure even under a dynamic topology on the basis of a nearest neighbor graph; hence, they do not require recognition capability. We confirm this by an analytical discussion of switched systems and a series of computer simulations.
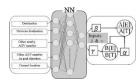
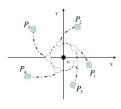## Room C

GS4 Artificial mind research

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

GS4-1   AGVs' control in autonomous decentralized FMS (AGVs' mind with neural networks)

Hidehiko Yamamoto, Hiroaki Tashiro, and Takayoshi Yamada
(Gifu University, Japan)

This paper describes control of the moving robots in an autonomous decentralized Flexible Manufacturing System (FMS) by moving robots according to its mind change. We propose Experience based Stimulation Adjustment by NN (ESAN) that is the method of efficiently changing the mind of the automated guided vehicles. The mind changes by various stimulation. In ESAN, the stimulation sent to the mind is adjusted to an appropriate value by using the neural network. The effectiveness of ESAN is evaluated with production simulations in an autonomous decentralized FMS virtual factory.

January 19 (Thursday), 15:20–16:20

GS4-2   Modelling mental representation as evolved second order learning

Solvi Fylgja Arnold, Reiji Suzuki, and Takaya Arita
(Nagoya University, Japan)

Mental representation is a fundamental aspect of advanced cognition. An understanding of the evolution of mental representation is essential to an understanding of the evolution of mind. However, being a decidedly mental phenomenon, its evolution is difficult to study. This research addresses the question of how representation ability may emerge from non-representational cognition. We reformulate cognitive map ability, a paradigm case of mental representation, in terms of second order learning. We provide a neural network species with neural mechanisms for second order change and evolve them in an environment of randomly generated Tolman mazes, known to require mental representation. Some runs of this model evolve near-optimal performance, providing support for the hypothesis that mental representation is evolved second order learning.

GS4-3   How equity norms evolve? – an evolutionary game theory approach to distributive justice
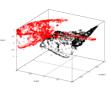
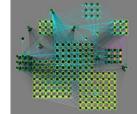Kazuaki Kojima and Takaya Arita
(Nagoya University, Japan)

A Nash demand game (NDG) has been applied to explain moral norms of distributive justice. In NDG, two players simultaneously make demands and receive them unless the sum of the demands exceeds the amount of the resource. Otherwise, they obtain nothing. This paper proposes the demand-intensity game (D-I game), which adds an "intensity" dimension to NDG in order to discuss various scenarios for the evolution of norms concerning distributive justice. We show basic analyses of the D-I game in game theory and then evolutionary simulations. Descriptive/evolutionary approaches show that three types of norms could evolve mainly dependent on the conflict cost in the game: egalitarianism, "wimpy" libertarianism and libertarianism in decreasing order of the cost. Although the wimpy libertarianism is classified as the libertarianism in the sense of claiming the full resource, it can achieve an egalitarian division without conflict cost as a result.

GS4-4   Dynamics of rules internalized in dynamic cognitive agents playing a multi-game

Takashi Sato
(Okinawa National College of Technology, Japan)

Rules such as laws, institutions, and norms can be changed dynamically in our society, because they are shaped by interactions among social members who are affected by them. However, there are also some stable rules enhanced by interactions among rules. In this article, we discuss whether or not rules can be stabilized by interactions among the rules. To investigate this, we propose a multi-game model in which different games are played simultaneously by the dynamic cognitive agents. A minority game (MG) and an n-person iterated prisoners' dilemma game (NIPDG) are adopted. In our simulation, we found that the agents internalize the complex rules expressed as intricate geometrical shapes like strange attractors on the phase spaces, when the complex macro dynamics emerged. Furthermore, it showed that the macro dynamics shaped by the macro rules in the MG can be stabilized by interaction between the MG and the NIPDG rules internalized in the agents.

January 19 (Thursday), 15:20–16:20

Room D

GS5 Bioinformatics

Chair: Young Im Cho (The University of Suwon, Korea)

GS5-1 On classification of interview sheets for ophthalmic examinations using self-organizing maps

Naotake Kamiura[1], Ayumu Saitoh[1], Teijiro Isokawa[1], Nobuyuki Matsui[1], and Hitoshi Tabuchi[2]
([1]University of Hyogo, Japan)
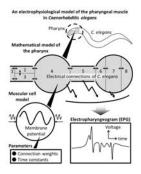([2]Tsukazaki Hospital, Japan)

In this paper, a method of determining examination groups for new patients is presented, using self-organizing maps. Assuming that interview sheets are divided into four classes, the method copes with the examination determination as the classification of the sheets. The data are generated from handwriting sentences in the sheets. Some nouns in them are picked up as elements of the data. After map learning is complete, its neurons are labeled. The class of the sheet corresponding to the data to be checked is specified by the label of the winner neuron for the data. It is established that the multiple-map-based scheme achieves favorable classification accuracy.

GS5-2 An electrophysiological model of the pharyngeal muscle in Caenorhabditis elegans

Yuya Hattori[1,2], Michiyo Suzuki[2], Zu Soh[3], Yasuhiko Kobayashi[2], and Toshio Tsuji[1]
([1]Hiroshima University, Japan)
([2]Japan Atomic Energy Agency, Japan)
([3]Osaka University, Japan)

The pharyngeal pumping motion to send food to the bowel is a rhythmic movement in Caenorhabditis elegans. We proposed a computer simulation of the pumping motion to investigate the mechanisms of rhythm phenomena in living organisms. To conduct the simulations we developed an electrophysiological model of the pharyngeal muscle that corresponds to the actual structure at a muscular level, and which generates the pumping rhythms. Each of 29 cells was modeled as a membrane potential model to simulate the internal response. The electrophysiological responses of the pharyngeal muscular cells were measured as an electropharyngeogram (EPG) that records the activities of the pharynx as a signal pattern, including the membrane potentials in multiple cells. We also developed an EPG model that calculated EPG based on the outputs of individual membrane-potential models. We confirmed that our model of the pharynx could generate rhythms similar to the EPG measured from C. elegans.

GS5-3 Origin of the Chukchee-Kamchatkan language family from the Paiwan language in Formosa: Evidenced by Swadesh basic vocabulary comparison, providing basic knowledge for understanding DNA haplotype distributions

Koji Ohnishi
(Niigata University, Japan)

Chukchee-Kamchatkan (ChKm) basic body-part name words (BBPs) in Swadesh 200 basic word vocabulary. were compared with ca. 1,300 basic words of 80 different Austronesian (AN) languages, which has resulted in finding 13 cognates of ChKm BBPs. Out of the 13 ChKm BBP word-items, 5.3 items were found to have cognate in Formosan, and 3.5 items in Paiwan. Chi-squared statistical test concluded that ChKm have evolved from the Paiwan language or its close kin language. The results were compared with the results from similar analyses of Formosan-related non-AN languages and Gilyak (Nivkh). Results were also discussed from aspects of mitochondrial and Y-chromosomal DNA-haplotype distributions.

GS5-4   A study on line length and direction perception via cutaneous sensation

Syed Muammar Najib Syed Yusoh, Yoshihiko Nomura, Ryota Sakamoto, and Kazuki Iwabu
(Mie University, Japan)

In this paper, we studied the contribution of the cutaneous sensation in the perception of the line segment's length and direction through psychophysical experiments where a mechatronic stage was utilized to express virtual line segments. The perceived lengths and directions were compared to the true values, and the mean errors, the standard deviations, and RMSE (Root Mean Square Error) were examined. As the results of the examinations, it was found as for the mean error of the perceived length that the more the length is increased from 10 to 90 mm, the more the subjects perceived decreased length from about 0 to 30%. As for the mean error of the perceived direction, another finding was that the subjects can recognize the direction with less than errors of about 10 degrees in the counter-clock wise direction.

Room E

GS12 Evolutionary computations

Chair: Shih-Cheng Horng (Chaoyang University of Technology, Taiwan)

GS12-1   Optimal base-stock policy of the assemble to order systems

Shih-Cheng Horng[1] and Feng-Yi Yang[2]
([1]Chaoyang University of Technology, Taiwan)
([2]National Yang-Ming University, Taiwan)

In this work, an ordinal optimization based evolution algorithm (OOEA) is proposed to solve for a good enough target inventory level of the assemble to order (ATO) system. First, the ATO system is formulated as a combinatorial optimization problem with integer variables that possesses a huge solution space. Next, the genetic algorithm (GA) is used to select N excellent solutions from the solution space, where the fitness is evaluated with the radial basis function (RBF) network. Finally, we proceed with the OCBA technique to search for a good enough solution. The proposed OOEA is applied to an ATO system comprising 10 items on 6 products. The good enough target inventory level obtained by the OOEA is promising in the aspects of solution quality and computational efficiency.

GS12-2   DNA sequencing by Max-Min Ant System and Genetic Algorithm

Tao Liu and Michiharu Maeda
(Fukuoka Institute of Technology, Japan)

This paper is concerned with DNA sequencing by hybridization. An algorithm that Max-Min Ant System and Genetic Algorithm (MMASGA) is proposed to solve the computational field of sequencing resulting from hybridization experiment. For avoiding the local minimum, MMASGA is based on Max-Min Ant System (MMAS), into which Genetic Algorithm (GA) is added. Before getting into the maximum iteration of MMAS, GA takes place in MMAS. In the numerical evaluation, with the iteration mounting up, the summation of the DNA probe appearance frequency turns more. The accuracy of the solution gotten by MMASGA is higher than MMAS.

January 19 (Thursday), 15:20–16:20

GS12-3   Advanced artificial bee colony algorithm detecting plural acceptable solutions

Masaaki Nishimoto, Akihide Utani, and Hisao Yamamoto
(Tokyo City University, Japan)

In many engineering applications (engineering design problems), since the environment and/or situation of applications may change, it is important to detect plural acceptable solutions (plural acceptable means). As a technique of detecting not a single global optimum solution but plural acceptable solutions, this paper proposes a new optimization algorithm based on advanced Artificial Bee Colony (ABC) algorithm that has the good performance on large scale optimization problems. We evaluate the proposed algorithm through numerical experiments on well-known benchmark functions, such as Rastrigin function and Schwefel function, and discuss its development potential. In numerical experiments, the performances of the proposed algorithm are compared with those of the existing optimization one based on Particle Swarm Optimization (PSO) algorithm for detecting plural acceptable solutions.

GS12-4   Multi-objective optimal path selection in the Electric Vehicles

Umair Farooq Siddiqi[1], Yoichi Shiraishi[1], and Sadiq M. Sait[2]
([1]Gunma University, Japan)
([2]King Fahd University of Petroleum & Minerals, Saudi Arabia)

Car navigation systems of the modern vehicles are equipped with an optimal path selection (OPS) unit. The OPS unit is responsible for finding the shortest paths between any source and destination nodes in the road network. In Electric Vehicles (EVs), the purpose of the OPS unit is to find multi-objective shortest paths (MOSP) w.r.t.: (i) Recharging Time, (ii) Distance, and (iii) Travelling Time. This work presents a memory efficient Simulated Evolution (SimE) based algorithm for solving the MOSP problem in EVs. The proposed algorithm uses innovative representation of the solution, and problem-specific goodness and allocation operations. Two different techinques for selecting the recharging stations are also proposed. The performance of the proposed algorithm is compared with NSGA-II, which is a popular population based heuristic for solving the multi-objective optimization problem. The comparsion results show that the proposed algorithm achieves the performance equal to NSGA-II while it requires 2.22 times lesser memory than any population based heuristic.
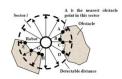
Room F

GS27 Robotics III

Chair: Yoko Amano (Nihon University, Japan)

GS27-1   An improved Bug-type navigation algorithm for mobile robots

Yi Zhu[1], Tao Zhang[1], Jingyan Song[1], Xiaqin Li[1], Xuedong Chen[2], and Masatoshi Nakamura[3]
([1]Tsinghua University, P. R. China)
([2]Huazhong University of Science and Technology, P. R. China)
([3]Research Institute of Systems Control, Saga University, Japan)

An improved Bug-type navigation algorithm that ensures convergence is proposed in this paper by integrating more heuristic information abstracted from the range data in the authors' previous work. While some similar concepts have been proposed before, the improved algorithm has fully considered many implementation issues that are ignored in the related works and therefore it is more practical than these works. Simulations show that compared with the authors' previous work, the improved algorithm can generate shorter average path length. Experiments on a real robot further verified its practicability.

GS27-2   Sound source detection robot inspired by water striders

Hiroki Nakatsuka and Kazuyuki Ito
(Hosei University, Japan)

In this study, we investigate a position search algorithm inspired by the behavior of a water strider, and we develop a six-legged robot that moves toward a sound source autonomously by using this algorithm. First, we observe the behavior of water striders by using a high-speed camera, and we simplify the observed behavior to obtain some rules. Then, we evaluate the validity and effectiveness of the obtained rules by conducting simulations. Finally, we develop a six-legged robot that is controlled on the basis of the obtained rules. Experimental results show that the developed robot effectively moves toward the sound source.

Room A

GS13 Genetic algorithms

Chair: Shigeru Nakayama (Kagoshima University, Japan)

GS13-1   A hybrid evolutionary algorithm for the resource constrained project scheduling problem

Arit Thammano and Ajchara Phu-ang
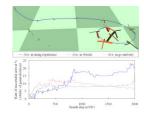(King Mongkut's Institute of Technology Ladkrabang, Thailand)

The resource constrained project scheduling problem (RCPSP) is an NP-hard optimization problem. RCPSP is one of the most important and challenging problem in the project management field. In the past few years, many researches have been proposed for solving the resource constrained project scheduling problem. The objective of this problem is to schedule the activities under the limited amount of the resources so that the project makespan is minimized. This paper proposes a new algorithm for solving RCPSP that combines the concepts of the biological immune system, the simulated annealing algorithm (SA), the tabu search algorithm (TS) and the genetic algorithm (GA) together. The performance of the proposed algorithm is evaluated and compared to the current state of the art metaheuristic algorithms. In this study, the benchmark data sets used in testing the performance of the proposed algorithm are obtained from Project Scheduling Problem Library (PSPLIB). The performance is measured in terms of the average percentage deviation from the critical path lower bound. The experimental results show that the proposed algorithm outperforms the state of the art metaheuristic algorithms on all standard benchmark data sets.

January 19 (Thursday), 16:40–18:25

GS13-2   Study on evolution of the artificial flying creature controlled by neuro-evolution

Ryosuke Ooe, Ikuo Suzuki, Masahito Yamamoto, and Masashi Furukawa
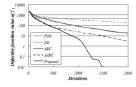(Hokkaido University, Japan)

In this paper a flight evolutionary simulation of an artificial flying creature (AFC) is described. The three-dimensional motion of the AFC is calculated by the physical engine PhysX and a numerical expression of the simple drag force. The AFC is controlled by an artificial neural network (ANN). The three-layered ANN which has nine input neurons and four output neurons is used for a simulation of the AFC. To evolve ANNs and to have the AFC flight suitably for given target points, a particle swarm optimization (PSO) optimizes parameters of ANNs. The results of evolutionary simulation show that the ability of generalization does not always increase as evolution progresses, and it depends on given tasks of the AFC. It is also shown that the number of situations which the AFC goes through has positive correlation with the ability of generalization.

GS13-3   A new differential artificial bee colony algorithm for large scale optimization problems

Takuya Kagawa, Akihide Utani, and Hisao Yamamoto
(Tokyo City University, Japan)

This paper proposes a novel optimization algorithm based on advanced Artificial Bee Colony (ABC) algorithm that has the good performance on large scale optimization problems named the differential ABC algorithm. In the proposed algorithm, the generation equation of the mutation vector of Differential Evolution (DE) is introduced in advanced ABC algorithm. We evaluate the proposed algorithm through numerical experiments on well-known benchmark functions, such as Rastrigin function, Schwefel function, Ackley function and Griewank function, and discuss its development potential. In numerical experiments performed, the performances of the proposed algorithm are compared with those of the existing optimization ones, such as Particle Swarm Optimization (PSO) algorithm, DE algorithm, ABC algorithm and advanced ABC algorithm.

GS13-4   A generation alternation model for user-system cooperative evolutionary computation

Satoshi Ono, Kiyomasa Sakimoto, and Shigeru Nakayama
(Kagoshima University, Japan)

User-System Cooperative Evolution (CEUS) is an Evolutionary Computation (EC) method to optimize quantitative and qualitative criteria. In previous work of CEUS, the whole population update is erformed at every generation, and the user hardly observes all individuals. This paper proposes a generation alternation model designed for CEUS. The proposed model allows a user to find widely varied individuals in addition to the best individuals by replacing just one individual in a population for each generation, and consequently contributes user's idea generation by enhancing divergent thinking. Experimental study showed that the proposed generation alternation modelhelped a user find various solutions not only the best individuals in the population.

GS13-5 A neutral evolutionary path-planner

Eivind Samuelsen, Kyrre Harald Glette, and Kazi Shah Nawaz Ripon
(University of Oslo, Norway)

This paper explores methods for path-planning using evolutionary algorithms. Inspired by research on neutral mutations in evolutionary algorithms, we propose an algorithm based on the idea of introducing redundancy in the solutions, adding explicit neutrality to the evolutionary system. The algorithm introduce explicit neutrality by evolving roadmaps rather than single paths. Since some of the mutation and crossover operators used in conventional evolutionary path-planners are not well suited for this representation, appropriate evolutionary operators will also be explored. The performance of this algorithm on shortest distance path planning problems is compared to a known good genetic algorithm in three different static environments.

Room B

GS16 Image processing I

Chair: Akira Yamawaki (Kyushu Institute of Technology, Japan)

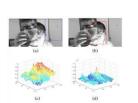### GS16-1 Hamming distance based gradient orientation pattern matching

Prarinya Siritanawan and Toshiaki Kondo
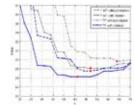(Thammasat University, Thailand)

This paper presents a novel pattern matching technique for motion estimation and visual tracking under varying illuminations, including a large amount of occlusions. To cope with the illumination problem, we previously proposed a matching technique using gradient orientation information, called gradient orientation pattern matching technique. Unlike conventional image features such as intensities and gradients, gradient orientations are known to be robust to illumination changes. In this paper, we introduce the Hamming distance to the gradient orientation pattern matching as a new similarity metric. Simulation results show that the new proposed method is robust to both illumination changes and a large amount of occlusions compared with existing matching techniques.

GS16-2 Microscopic image restoration based on tensor factorization of rotated patches

Masayuki Kouno[1], Ken Nakae[1], Shigeyuki Oba[2], and Shin Ishii[1]
([1]Kyoto university, Japan)
([2]Japan Science and Technology Agency, Japan)

In microscopic image processing for analyzing biological objects, structural characters of objects such as symmetry and direction can be used as a prior knowledge to improve the result. In this study, we incorporated filamentous character of local structures of neurons into a statistical model of image patches so as to obtain an image processing method based on tensor factorization with image patch rotation. Tensor factorization enabled us to incorporate correlation structure between neighboring pixels, and patch rotation helped us obtain image bases that well reproduce filamentous structures of neurons. We applied the proposed model to a microscopic image and found significant improvement in image restoration performance over existing methods even with smaller number of bases.

January 19 (Thursday), 16:40–18:25

GS16-3   Robotic applications of a defensible error-aware super-resolution technique

Jeremy Straub
(University of North Dakota, USA)

Many robotics applications rely on computer vision for long-term route planning. Increased resolution increases the effective planning timeframe. Basic super resolution is generally unsuitable for robotic planning as the level of accuracy of the enhanced data is unknown. A framework for reporting confidence for super-resolution enhancement is presented. This approach includes a numeric confidence map along with the super-resolved data. The AI consumer of the enhanced data can, thus, consider both the data and confidence meta-data when making decisions. The super-resolution system is trained via database storage of patterns from high-resolution images. This allows combined sets to be created to suite application requirements and facilitates set reuse. The confidence-reporting framework is applicable to any robotics application where enhanced imagery can be beneficial for planning or other AI processing. Applications in UAV navigation and planning, robotic ground exploration, and spacecraft navigation are discussed.

GS16-4   A study on situation recognition in wide area by aerial image analysis

Ganwen Jiang, Jun Yoshida, Masayuki Kashima, Kiminori Sato, and Mutsumi Watanabe
(Kagoshima University, Japan)

Recently, social security and natural disasters are worrying. In order to solve these problems and to reduce the damage, wide-area monitoring by computer vision is needed. Traditional monitoring systems have many problems that are caused by limited visual field in conventional technique. In this research, the air vehicle system which is to track a particular person indoors and outdoors where there are multiple people exist is proposed. Besides that, the four blades helicopter as a flying robot named AR.Drone is used. On experimental method, Hough transform method, Histogram method, Snakes method and Particle filter method are used in the research. Experimental results indoors and outdoors have shown the effectiveness of the proposed methods. The purpose of the study is to perform a wide area situation recognition and autonomous control of flying robot indoors and outdoors.
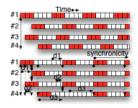
The Seventeenth International Symposium on Artificial Life and Robotics 2012 (AROB 17th '12),
B-Con Plaza, Beppu, Oita, Japan, January 19-21, 2012

January 19 (Thursday), 16:40–18:25

Room C

GS21 Multi-agent systems

Chair: Hidehiko Yamamoto (Gifu University, Japan)

GS21-1　An implementation of firefly-inspired network synchronicity without leaders on a of small wireless devices

Fujio Yamamoto
(Kanagawa Institute of Technology, Japan)

Synchronicity observed in a group of fireflies was reconstructed using SunSPOTs. It is based on the software simulation with phase delay model. The main purpose is to provide a method for performing synchronicity among electronic fireflies, rather than obtaining clock synchronization. Some problems arising from the use of real wireless devices, not occurred in the simulation, were addressed and solved. The most important problem was how to send and receive phase delay information among SunSPOTs using real ratio signal. This is not the problem in the simulation because the detection of other flashes can be immediately obtained by simple calculations. The results from the proposed implementation exhibit relatively good synchronicity although its accuracy is not so high. These can be useful to observe synchronous behavior in the biological population without leaders.

GS21-2　An improved clustering based Monte Carlo Localization approach for cooperative multi-robot localization

Guanghui Luo[1], Dan Wu[1], and Libing Wu[2]
([1]University of Windsor, Canada)
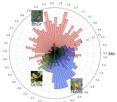([2]Wuhan University, P. R. China)

We describe an approach for cooperative multi-robot localization based on Monte Carlo Localization. In our approach, each of the robots maintains its own clustering based MCL algorithm, and communicates with each other whenever it detects another robot. We develop a new information exchange mechanism, which makes use of the information extracted from the clustering component, to synchronize the beliefs of detected robots. By avoiding unnecessary information exchange whenever detection occurs through belief comparison, the proposed approach solves the delayed integration problem which further improves the effectiveness and efficiency of multi-robot localization. This approach has been tested in both real and simulated environments. Compared with single robot localization, the experimental results demonstrate that proposed approach notably improves the performance, especially when the environments are highly symmetric.

GS21-3　Soundscape partitioning to increase communication efficiency in bird communities

Reiji Suzuki[1], Charles E. Taylor[2], and Martin L. Cody[2]
([1]Nagoya University, Japan)
([2]University of California, USA)

Birds do not always vocalize at random, but may rather divide up sound space in such a manner that they avoid overlap with the songs of other bird species. In effect, a high degree of communication efficiency can be achieved by many simultaneously active vocalists that finely integrate songs with minimal overlap. We describe this phenomenon from several recordings at our principal study location, near Volcano, California. Among the most-studied models for conceptualizing and studying such de-synchronized systems come from scheduling algorithms in computer science, where internet protocols involve packets of information that are broadcast widely; any collisions between them will corrupt the colliding packets so that they need to be resent. We have simulated some of these methods that might be appropriate for the soundscape of bird communities. Some features of these de-synchronized depend on specifics of the algorithms used.

January 19 (Thursday), 16:40–18:25

GS21-4   A cooperative self-localization method based on group robot information sharing

Yuichi Kitazumi, Noriyuki Shinpuku, and Kazuo Ishii
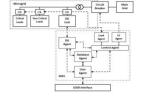(Kyushu Institute of Technology, Japan)

In the RoboCup MSL (Middle Size League), since each robot should realize the obstacle avoidance, path planning, and cooperative behavior, self-localization is basic and important process. Our system aims at improvement of self-localization accuracy of each robot in multi agent environment. At first, we determine to use the ball as the landmark for all teammate robots. Since all robots have possibility to include the measurement error in real environment, the landmark's existence probability can be expressed by the Gaussian distribution. In our platform robots, all robots share the position information via wireless LAN. Then each robot evaluates the proper position of the landmark based on the landmark's existence probability. Finally, each robot corrects its position based on the landmark position, that is, the obtained ball position.
As evaluation of the proposed system in real environment, the accuracy evaluation experiments were conducted using the soccer robot "Musashi".

GS21-5   Dual layered multi agent system for intentional islanding operation of microgrids

Asitha Lakruwan Kulasekera[1], Ranathunga Arachchilage Ruwan[1], Manjula Udayanga Hemapala[1],
Nuwan Perera[1], and Achala Pallegedara[2]
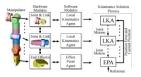([1]University of Moratuwa , Sri Lanka)
([2]Saga University, Japan)

The paper focuses on proposing a dual layered, multi agent based control system for distributed control of a microgrid aimed at intentional islanding. The architecture consists of two layers; primary layer and secondary layer. The primary layer includes a User agent, a Distributed Generator (DG) agent and a Control agent. The secondary layer consists of a Low Voltage (LV) agent and a Load agent. The Control agent is capable of supervising the secondary layer agents. The proposed multi agent based control architecture is developed using the JADE platform and it is used to control a microgrid simulated in MATLAB/SIMULINK. In order to validate the effectiveness of the proposed method, investigations are carried out for islanding scenarios simulated on the test network. The results of this study show the capability of developing a reliable control mechanism for islanding operation of microgrids based on the proposed concept.

GS21-6   Multi-agent framework for kinematics process of redundant multi-link robots

Shinya Haramaki[1], Akihiro Hayashi[2], Toshifumi Satake[3], and Mochimitsu Komori[2]
([1]Ariake National College of Technology, Japan)
([2]Kyushu Institute of Technology, Japan)
([3]Asahikawa National College of Technology, Japan)

This paper proposes a framework of a distributed kinematics process model applied to multi-link robots. In the framework, hardware modules which consists of joints and links are defined as joint components of robotic systems, then kinematics models are composed of a set of the local kinematics Agents (LKAs) which are software module to compute the localized direct and inverse kinematics. Kinematics of robotic systems is resolved by the localized kinematics calculation of LKAs for an end effecter to a target position and an information exchange among LKAs. The proposed framework has been applied to case study of the inverse kinematics problems of 7 degree of freedom redundant multi-link robot manipulator.
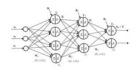
Room D

GS22 Neural networks I

Chair: Eiichi Inohira (Kyushu Institute of Technology, Japan)

GS22-1 Optimizing the thermoforming of polypropylene foam by an artificial neural network

Shih-Jung Liu, Ting-Ting Wen, and Yau-Zen Chang
(Chang Gung University, Taiwan)

In this study, the optimal processing parameters of polypropylene foam thermoforming are obtained by the use of an artificial neural network. Data from tests carried out on a lab-scale thermoforming machine were used to train an artificial neural network, which serves as an inverse model of the process. The inverse model has the desired product dimensions as inputs and the corresponding processing parameters as outputs. The structure, together with the training methods, of the artificial neural network is also investigated. The feasibility of the proposed method is demonstrated by experimental manufacturing of cups with optimal geometry derived from the finite element method. Except the dimension deviation at one location, which amounts to 17.14 %, deviations of the other locations are all below 3.5 %.

GS22-2 Situational judgment system for a robot in complex environments using hierarchical neural network

Anri Nishimoto and Hitoshi Sori
(Tsuyama National College of Technology, Japan)

Human-beings can prevent crashes by avoiding obstructions when detected it in front of them. At the same time, they can take the best action suitable to the surrounding environment. It is considered that an action control algorithm for a mobile robot is feasible by imitating the above-mentioned action control of human-beings. In this paper, we propose a situational judgment system using a hierarchical neural network. This system outputs the action suitable for a robot to the environment (go straight, go back, turn right, turn left, diagonally forward right, or diagonally forward left). After learning of the system, we mounted the system into the robot and let the robot judge the action in various environments. The experimental results demonstrated that the proposed system was effective for determination of the action of the robot in complex environments.

January 19 (Thursday), 16:40–18:25

GS22-3 Medical image diagnosis of lung cancer by multi-layered GMDH-type neural network self-selecting functions

Tadashi Kondo, Junji Ueno, and Shoichiro Takao
(The University of Tokushima, Japan)

In this study, a revised Group Method of Data Handling (GMDH)-type neural network self-selecting optimum neuron architectures is applied to the computer aided image diagnosis (CAD) of lung cancer. The GMDH-type neural network algorithm has an ability of self-selecting optimum neural network architecture from three neural network architectures such as sigmoid function neural network, radial basis function (RBF) neural network and polynomial neural network. The GMDH-type neural network also has abilities of self-selecting the number of layers, the number of neurons in hidden layers and useful input variables. This algorithm is applied to CAD and it is shown that this algorithm is useful for CAD of lung cancer and is very easy to apply practical complex problem because optimum neural network architecture is automatically organized.

GS22-4 The technique of the online learning method using SOM algorithm for nonlinear SVM

Hiroki Tamura, Takeshi Yoshimatsu, and Koichi Tanno
(University of Miyazaki, Japan)

The support vector machine (SVM) is known as one of the most influential and powerful tools for solving classification and regression problems, but the original SVM does not have an online learning technique. Therefore, many researchers have introduced online learning techniques to the SVM. In a previous article, we proposed an unsupervised online learning method using the technique of the self-organized map for the SVM. In another article, we proposed the midpoint validation method for an improved SVM. We test the performance of the SVM using a combination of the two techniques in this article. In addition, we compare its performance with the original hard margin SVM, and also experiment with our proposed method on surface electromyogram recognition problems with changes in the position of the electrode, and the numerical experiment recognition problem with changes in the time. These experiments showed that our proposed method gave a better performance than the SVM and corresponded to the changing data.

GS22-5 Financial market forecasting by integrating wavelet transform and k-means clustering with support vector machine

W.D.S Roshan, R.A.R.C Gopura, A.G.B.P Jayasekara, and D.S.V Bandara
(University of Moratuwa, Sri Lanka)

Financial market forecasting is a challenging problem and researchers are still exploring the ways to improve the performance of the existing models. This paper presents a forecasting model by integrating wavelet transform, K-means clustering with support vector machine. At the first stage, noise of the input prices is removed by using wavelet denoising. Wavelet multiresolution analysis is used to decompose the original time series in to multiple details and approximated decompositions. Individual support vector models are trained for each detail part. Approximated part is further analyzed by clustering and training support vector models for each cluster. Finally the forecast is made for the wavelet denoised time series by summing up the forecasts of each support vector model. Results have shown that the proposed model has given the accurate forecast and has the capability to support decisions in real world trading.

January 19 (Thursday), 16:40–18:25

Room E

GS24 Pattern recognition

Chair: Mohd Rizon (King Saud University, Saudi Arabia)

GS24-1   Handwriting character classification using Freeman's olfactory model

Masanao Obayashi, Shinnosuke Koga, Liangbing Feng, Takashi Kuremoto, and Kunikazu Kobayashi
(Yamaguchi University, Japan)

Recently, researches on smell sense that is one of the sensory organs of man have been actively done. The KIII model is one of the olfactory models that is thought out by Freeman referring to a physiological structure of mammal's olfactory system. In this paper, we propose a commonly used feature extraction method that applies Fourier transformation to the behavior of the time series and also propose to use the dynamics of chaotic neuron instead of the Hodgkin-Huxley equation to reduce computation time. Our introduced structure of the chaotic neuron has the simple structure and that it makes possible the chaotic operation same as the Hodgkin-Huxley equation. Paying attention to the point that the human brain does a similar processing to any sense of information, the hand-written image recognition problem that uses the KIII model is adopted as the computation simulation. Through the computer simulation of the handwriting character classification, it is shown that the proposed method is useful in the point of both computation time and the recognition accuracy.

GS24-2   A corner detection technique using unit gradient vectors

Pramuk Boonsieng, Toshiaki Kondo, and Waree Kongprawechnon
(Thammasat University, Thailand)

This paper presents a novel method for detecting corners in an image irrespective of the contrast. The corner detection method proposed by Kanade, Lucas, and Tomasi (KLT), Ando, and Harris corner detector are among the most widely used algorithms. They are all based on image gradients. Thus, the performances of those conventional approaches depend on the contrast of images. They work well for high-contrasted patterns, but have a difficulty in detecting low-contrasted corners. To overcome the problem, we propose to use unit gradient vectors (UGVs), instead of gradients, because UGVs are known to be a robust image feature and invariant to image contrast.

GS24-3   Human detection employing the HOG feature based on multiple scale cells

Yusuke Ehara, Tan Joo Kooi, Seiji Ishikawa, and Takashi Morie
(Kyushu Institute of Technology, Japan)

In this paper, we propose a new human detection method based on local descriptors and machine learning. The HOG feature and RealAdaBoost are well-known methods for detecting humans. However, this technique has shown its limitation because of long processing time due to fixed number of weak-classifiers. To overcome this problem, this paper proposes a HOG based framework using multiple-scale cells for the RealAdaBoost with a variable number of weak-classifiers. The proposed method is faster than existent methods, because it describes more comprehensive intensity gradients and classifies them using low dimension feature vectors. Experimental results show that the proposed method is effective in accuracy and processing time.

January 19 (Thursday), 16:40–18:25

GS24-4　Hash based early recognition of gesture patterns

Yoshiyasu Ko, Atsushi Shimada, Hajime Nagahara, and Rin-ichiro Taniguchi
(Kyushu University, Japan)

We propose an accelerated approach of gesture recognition, "Early Recognition". Early recognition is a method to make a decision of human gesture at their beginning part of it. A gesture consists of a sequential postures. In the training phase, a lot of postures which make the gestures are trained by Self-Organizing Map (SOM). Then, representative postures on the SOM are investigated their contribution ratios for each gesture. Besides, the representative postures are registered into a hash table to realize quick search of a posture in the test phase. When an input gesture is given, a posture in each frame is used as a query and the most similar posture is found from the training samples. Then, if the contribution ratio for a certain gesture exceeds a predefined threshold, the system outputs the gesture label as the recognition result. Through our experiments, we found out that the proposed method outperformed the traditional ...

GS24-5　Source recognition in acoustic sensor arrays using self-organizing hidden Markov models

Edgar E. Vallejo[1], Julio G. Arriaga[1], and Charles E. Taylor[2]
([1]ITESM Campus Estado de México, México)
([2]University of California, USA)

In this paper, we present a computational model for source recognition in acoustic sensor arrays. The proposed model uses a hybrid method of neural networks to create symbols then hidden Markov models that collectively learn to discriminate sequences of symbols from a collection of recordings from bird species with minimum human intervention. Preliminary simulation results indicate that this model is capable of producing acceptable levels of classification performance.

GS24-6　Japanese finger-spelling recognition using a chest-mounted camera

Akira Nagasue, Tan Joo Kooi, Hyoungseop Kim, and Seiji Ishikawa
(Kyushu Institute of Technology, Japan)

This paper proposes a technique for recognizing Japanese Finger-spelling using a sign language user's chestmounted camera. Unlike existent systems, the technique employs a sign language user's chest-mounted camera attached to the sign language user himself and recognizes his/her sign language through the captured images of Japanese Finger-spelling. We use a silhouette picture of a hand, and MHI (Motion History Image) for Japanese finger-spelling recognition. The recognition method uses the eigenspace method. Furthermore, in order to recognize Japanese finger-spelling from an animation (image sequence), a character segmentation technique is also proposed. Finally, finger characters are recognized and the performance is shown experimentally.

Room F

GS28 Robotics IV

Chair: Chair: Yoko Amano (Nihon University, Japan)

GS28-1   Stability of two-wheeled mobile robot using new combined pole-placement method

Yoko Amano
(Nihon University, Japan)

In order to guarantee the robotic stability, a new combined pole-placement method is proposed in this paper. The proposed method combines the LQR into the pole-placement design. Firstly, a mathematical model of the two-wheeled mobile robot is analytically derived. Secondly, the LQR for the model is designed, and optimal poles can be obtained from the designed LQR. Thirdly, the selection conditions of the best poles are the following; 1) the guarantee of convergence speed of the mobile robot, 2) control of the number of vibration times for the mobile robot, 3) saturation evasion of the control input to the mobile robot's actuators, 4) the ratio of an imaginary part and a real part is carried out near one of the selected poles. The pole-placement method selects the best poles than the optimal poles. Finally, the stability of the proposed method is confirmed by experiment results.

GS28-2   Phrase and music search engine for musical data

Kentarou Minowa and Eiji Hayashi
(Kyushu Institute of Technology, Japan)

A highly skilled pianist is able to play an unfamiliar piece of music by sight, even if the performance is not completely in accord with an intended specific musical interpretation. Current computing systems cannot perform a new piece of music by sight, and thus they cannot simulate a human pianist's musical expressions. We developed a system that searches for similar phrases throughout a musical score and infers the style of the performance. The method for searching for similar phrases using DP matching and for inferring performance expression with the best alignment of DP matching. In this paper, we describe the results of searching and inferring for similar phrases using DP matching, and we provide an evaluation of these results.

GS28-3   Control of real world complex robots using a biologically inspired algorithm

Fabio DallaLibera[1,2], Shuhei Ikemoto[2], Hiroshi Ishiguro[2], and Koh Hosoda[2]
([1]Padua University, Italy)
([2]Osaka University, Japan)

Elementary living beings, like bacteria, are able to reach food sources using only limited and very noisy sensory information. In this paper we describe a very simple algorithm inspired from bacteria chemotaxis. We present a Markov chain model for studying the effect of noise on the the behavior of an agent that moves according to this algorithm, and we show that, counterintuitively, the application of noise can increase the expected average performance over a fixed available time. After this theoretical analysis, experiments on real world application of this algorithm are introduced. In particular, we show that the algorithm is able to control a complex robot arm, actuated by 17 McKibben pneumatic artificial muscles, without the need of any model of the robot or of its environment.

January 19 (Thursday), 16:40–18:25

GS28-4   Control method for a redundant robot using stored instances

Yuya Okadome, Yutaka Nakamura, and Hiroshi Ishiguro
(Osaka University, Japan)

A robot operating in a real environment, as opposed to industrial robot working in factory, must have the flexibility to cope with disturbances and irregular factors. In this paper, we propose a control method where the control signal is selected from past experiences (stored instances) of a similar situation, according to the evaluation of each instance. We apply our method to the control of a robot with complicated structure, driven by several elastic actuators. Experimental results show that the control of a robot with many DOFs can be achieved by the proposed method.

GS28-5   Proposal of semiautonomous centipede-like robot for rubbles

Shota Kashiwada and Kazuyuki Ito
(Hosei University, Japan)

In this paper, we propose a multi-legged robot that is designed for operating on rubble. Generally, conventional multi-legged robots have many actuators for driving the legs and body. Hence, control in the case of these robots is more complicated than that in the case of crawler robots, and it is very difficult to operate multi-legged robots adaptively in a complex environment like rubble. To solve this problem, we have designed a mechanism of the legged-robot for reducing the controller load by utilizing a passive mechanism. To design the robot, we focus on a centipede. First, we observe the behavior of a centipede by using a high-speed camera, and then, to realize this behavior by a simple mechanism, we propose a multi-legged robot that is realized by connecting many links serially through rubber joints. In this mechanism, every joint has a leg on both sides, and the robot moves regularly like a centipede. The elasticity of the rubber joints compensates for the bumps on the ground. To control the moving direction, wires are installed through the links, and by pulling the wires, the body of the robot can be lifted up or turned. By simply pulling the suitable wires, we can control the moving direction of the robot. We do not have to control many joints individually for crossing bumps. They can move passively and can cross the bumps. To demonstrate the effectiveness of the proposed robot, we have developed a prototype robot and conducted certain experiments. The results show that the robot can move on rubble to desired positions.

January 20 (Friday), 08:40–09:40

Room A

GS1 Artificial brain research

Chair: Hiroshi Tanaka (Tokyo Medical & Dental University, Japan)

GS1-1   Binary MEMS optically reconfigurable gate array for an artificial brain system

Yuichiro Yamaji and Minoru Watanabe
(Shizuoka University, Japan)

Optically reconfigurable gate arrays (ORGAs) consisting of a holographic memory, a laser diode array, and a programmable gate array were developed to realize an artificial brain system for robots. In the ORGA, much information or many reconfiguration contexts can be stored in a volume-type holographic memory and can be programmed dynamically onto a programmable gate array at nanosecond-order perfectly in parallel. Therefore, by exploiting the huge storage capacity of the holographic memory and large parallel operations on a programmable gate array, huge parallel brain operations can be executed quickly on an ORGA. This paper presents a proposal of a binary MEMS-interleaving reconfiguration operation on an optically reconfigurable gate array for an artificial brain system.

January 20 (Friday), 08:40–09:40

GS1-2 Synaptic redistribution and variability of the signal release probability at hebbian neurons in a dynamic stocsastic neural network

Subha Danushika Fernando, and Koichi Yamada
(Nagaoka University of Technology, Japan)

This paper presents the finding of the research we conducted to evaluate the variability of signal release probability at Hebb's presynaptic neuron under different firing frequencies in a dynamic stochastic neural network. According to our results, synaptic redistribution has improved the signal transmission for the first few signals in the signal train by continuously increasing and decreasing the number of postsynaptic 'active receptors' and presynaptic 'active-transmitters' within a short time period. In long-run at low-firing frequency it has increased the steady state efficacy of the synaptic connection between Hebbian presynaptic and postsynaptic neuron in terms of the signal release probability of 'active-transmitters' in the presynaptic neuron. However, this 'low-firing' frequency of the presynaptic neuron has been identified by the network when compared it to the ongoing frequency oscillation of the network.

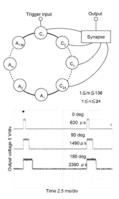### GS1-3 Properties of Hopfield model with the zero-order synaptic decay

Ryota Miyata[1], Jun Tsuzuruki[2], Toru Aonishi[1], and Koji Kurata[3]
([1]Tokyo Institute of Technology, Japan)
([2]Okayama University of Science, Japan)
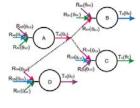([3]University of the Ryukyus, Japan)

In this paper, we investigate the effect of synaptogenesis on memories in the brain, using the abstract associative memory model, Hopfield model with the zero-order synaptic decay. Using the numerical simulation, we demonstrate the possibility that synaptogenesis plays a role in maintaining recent memories embedded in the network while avoiding overloading. For the network consisting of 1000 units, it turned out that the minimum decay rate to avoid overloading is 0.02, and the optimal decay rate to maximize the storage capacity is 0.08. We also show that the average numbers of replacement synapses at each learning step corresponding to these two values are 1187 and 21024, respectively.
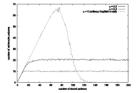
GS1-4 Pulse-type hardware neural networks circuit for PWM servo motor control

Ken Saito, Masahiko Kato, Minami Takato, Yoshifumi Sekine, and Fumio Uchikoba
(Nihon University, Japan)

This paper presents pulse-type hardware neural networks circuit (P-HNNC) which could control pulse width modulation (PWM) servo motor of robots. Basic components of P-HNNC were pulse-type hardware neuron model (P-HNM). P-HNM generated oscillatory patterns of electrical activity such as living organisms. Basic components of the P-HNM corresponding to the cell body circuit, the axon circuit and the synaptic circuit. P-HNM had the same basic features of biological neurons such as threshold, refractory period, spatio-temporal summation characteristics and enabled the generation of continuous action potentials. P-HNM was constructed by MOSFETs without any inductors could be integrated by CMOS technology. As a result, we showed that P-HNNC could control the PWM servo motor from 0 to 180 degrees. Same as the living organisms, P-HNNC realized the control of PWM servo motor without using any software programs, or A/D converters.

January 20 (Friday), 08:40–09:40

Room B

GS14 Human-machine cooperative systems

Chair: Kuu-young Young (National Chiao Tung University, Taiwan)

GS14-1　Manipulating a multi-DOF robot manipulator for tasks in home-like environments

Mu-Cheng Hsieh, Po-Ying Tseng, Ming-Shiun Jan, and Kuu-young Young
(National Chiao Tung University, Taiwan)

As more robots are expected to enter the families to provide assistance soon, many challenging problems shall emerge, when facing the uncertain and varying environments, rather than the organized environments in factories. To date, robots still demand human's assistance when working in home-like environments. To enhance their usefulness, one issue of much interest is how we can effectively operate them for task execution. If not for detailed analysis and program coding, one appealing alternate is to provide a kind of manipulative system for the user to manipulate the robot naturally and efficiently. That motivates us to develop a dextrous manipulation system for multi-DOF robot manipulators based on using the 6-DOF force-reflection joystick. To demonstrate its effectiveness, the developed manipulation system is utilized to govern the robot manipulator for the tasks of water pouring and screw fastening.

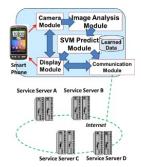### GS14-2　An article retrieval support system that accepts arbitrary Kansei words

Yuichi Murakami, Shingo Nakamura, and Shuji Hashimoto
(Waseda University, Japan)

In most article retrieval systems using Kansei words, there exists a gap between user's Kansei and system's Kansei model. Therefore, it is not always easy to retrieve the desirable articles. The purpose of this paper is to bridge this gap by introducing a novel function to accept arbitrary Kansei words. The parameters related to newly added Kansei words are automatically estimated from articles selected by the user during search. Thereby, the system is customized for individual users, to bridge the gap. In the evaluation experiments, we took actual paintings as the articles, and evaluated the user-satisfaction, accuracy, novelty and serendipity of the system through actual user operations. Most of users were satisfied with the system and could find unknown desirable articles. Moreover they could often find unexpectedly interested articles.

GS14-3　Design of a user-support system for vision information using a smart phone

Hiroyuki Nishiyama and Fumio Mizoguchi
(Tokyo University of Science, Japan)

In this paper, we design a user-support system for vision information using smart phones. When the user takes a picture of a target using the smart phone camera, our system can recognize the image of the target and recommend a suitable service to the user. The system with executes simple image analysis and determines a suitable service for the target image. The simple image analysis can extract 13 parameters (e.g., color information (RGB), number of intersections, depth of intersection, line width, and line depth). We use machine learning to classify the parameters into each service. In our research, we use a Support Vector Machine (SVM) as a learning machine tool. Our system design provides user support for several services such as translation, barcode readers, and diagnosis of skin images and demonstrates the effectiveness of our research.

January 20 (Friday), 08:40–09:40

GS14-4   **Producing text and speech from video images of lips movement photographed in speaking Japanese by using mouth shape sequence code - An experimental system to communicate with hearing impaired persons -**

Shiori Kawahata, Eiko Koyama, Tsuyoshi Miyazaki, and Fujio Yamamoto
(Kanagawa Institute of Technology, Japan)

We proposed a method to detect distinctive mouth shapes from images that uttered Japanese. And a method to realize machine lip-reading from the order of detected mouth shapes was proposed. Therefore, we propose a communication system for hearing impaired persons using the machine lip-reading. This system supports the communication with the hearing impaired persons and remote persons using the Twitter. In addition, the input of the message is realized with machine lip-reading because hearing impaired persons have difficulty in utterance by the voice. We also devise the interface which can be operated only with a mouse. We carry out an experiment to send a message which is input with machine lip-reading to the Twitter, and evaluate this system.

Room C

GS18 Intelligent control & modeling I

Chair: Shigeru Nakayama (Kagoshima University, Japan)

GS18-1   Reinforcement learning with phased approach for fast learning

Norifumi Hodohara, Yuichi Murakami, Shingo Nakamura, and Shuji Hashimoto
(Waseda University, Japan)

In this paper we consider the reduction of the computational cost of reinforcement learning. When we apply the reinforcement learning to a robot with a large number of DOF, it needs a tremendous amount of time for learning because of the large state space. This problem is called "the curse of dimensionality". To solve the problem, we propose a phased approach on reinforcement learning. In the proposed method, we apply reinforcement learning to a robot with limited DOF at first, then release the restriction and resume the learning from the previous learning result. The computer simulation using arm robots having four and five joints proved the effectiveness of the proposed method. We also conducted an experiment in the case that an obstacle exists around the arm.

GS18-2   Identification of continuous-time Hammerstein systems using Gaussian process models trained by particle swarm optimization

Tomohiro Hachino and Shouichi Yamakawa
(Kagoshima University, Japan)

This paper deals with a nonparametric identification of continuous-time Hammerstein systems using Gaussian process (GP) models. A Hammerstein system consists of a memoryless nonlinear static part followed by a linear dynamic part. The identification model is derived using the GP prior model which is described by the mean function vector and the covariance matrix. This prior model is trained by the separable least-squares approach combining particle swarm optimization with the linear least-squares method to minimize the negative log marginal likelihood of the identification data. Then the nonlinear static part is estimated by the predictive mean function of the GP, and the confidence measure of the estimated nonlinear static part is evaluated by the predictive covariance function of the GP. Simulation results are shown to illustrate the proposed method.

January 20 (Friday), 08:40–09:40

GS18-3　Reinforcement learning in dynamic environment -Abstraction of state-action space utilizing properties of the robot body and environment-

Yutaka Takeuchi and Kazuyuki Ito
(Hosei University, Japan)

In this paper, we address the autonomous control of a 3-dimensional snake-like robot through the use of reinforcement learning, and we apply it in a dynamic environment. In general, snake-like robots have high mobility that is realized by many degrees of freedom, and they can move over dynamically shifting environments such as rubble. However, this freedom and flexibility leads to a state explosion problem, and the complexity of the dynamic environment leads to incomplete learning by the robot. To solve these problems, we focus on the properties of the actual operating environment and the dynamics of a mechanical body. We design the body of the robot so that it can abstract small, but necessary state-action space by utilizing these properties, and we make it possible to apply reinforcement learning. To demonstrate the effectiveness of the proposed snake-like robot, we conduct experiments; from the experimental results we conclude that learning is completed within a reasonable time, and that effective behaviors for the robot to adapt itself to an unknown 3-dimensional dynamic environment were realized.

Room D

GS20 Learning

Chair: János Botzheim (Széchenyi István University, Hungary)

GS20-1　Adaptive reinforcement learning based on degree of learning progress

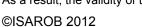Akihiro Mimura and Shohei Kato
(Nagoya Institute of Technology, Japan)

In this paper, we propose adjustment method named adaptive learning rate considering learning progress (ALR-P). The learning rate is a meta parameter that balances trade-off between speed and stability of the learning. Conventionally, designer had to manually set up a fixed learning rate. However, it is difficult for learning agent to adapt dynamic environment with a fixed learning rate. ALR-P enables adaptive adjustment of learning rate based on degree of learning progress for every steps. The degree of learning progress is calculated based on TD-error which is a difference of predicted and observed rewards. Only TD-error which can be calculated easily and simply is used in the ALR-P, so it can be applied into any types of reinforcement learning. We confirm effectiveness of ALR-P under a number of dynamic environments through the maze problem in which the environmental changes occurred.
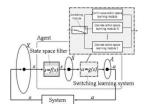
GS20-2　Developing reinforcement learning for adaptive co-construction of continuous state and action spaces
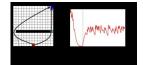
Masato Nagayoshi[1], Hajime Murao[2], and Hisashi Tamaki[2]
([1]Niigata College of Nursing, Japan)
([2]Kobe University, Japan)

Engineers and researchers are paying more attention to reinforcement learning (RL) as a key technique in developing autonomous systems. Our approach mainly deals with the problem of designing state and action spaces.
Recently an adaptive state space construction method which is called a "state space filter," and an adaptive action space construction method which is called a "switching learning system," have been proposed after the other space has been fixed. Here, we reconstitute these two construction methods as one method by treating them as a combined method for mimicking an infant's perceptual and motor developments. Then, a computational experiment was carriend out using a so-called "robot navigation problem" with three-dimentional continuous state space and two-dimensional continuous action space. As a result, the validity of the proposed method has been confirmed.

GS20-3 Reinforcement learning approach to multi-stage decision making problems with changes in action sets

Takuya Etoh, Hirotaka Takano, and Junichi Murata
(Kyushu University, Japan)

Multi-stage decision making (MSDM) problems often include changes in practical situations. For example travelling time of a path changes in the path selection problems in road networks. The changes cause risks in adopting solutions to MSDM problems. Therefore, we propose a method for solving MSDM problems considering risks. Reinforcement learning (RL) is adopted as a method for solving those problems, and stochastic changes of action sets are treated. It is necessary to evaluate risks besed on subjective views of decision makers (DMs) because the risk evaluation is by nature subjective and depends on DMs. Therefore, we develop an RL approach to MSDM problems with stochastic changes in sets of alternative actions, which uses new method for evaluating risks of the changes. The effectiveness of the method is illustrated with a road network path selection problem.

GS20-4 Reduction of learning space by making a choice of sensor information

Yasutaka Kishima, Kentarou Kurashige, and Toshinobu Numata
(Muroran Institute of Technology, Japan)

There are many researches about applying machine learning to robot. Robot uses sensors as input information for learning. When robot performs various task, sensors which are used for each task is important. The reason is important sensors for performing task are different in each task. Robot should use proper sensors for each task. Therefore, we will propose a method which robot can autonomously make a choice of important sensors for each task. We define measure of importance of sensor for task. The measure is coefficient of correlation between sensor value of each sensor and reward on reinforcement learning. Robot decide important sensors based on correlation. Robot reduce learning space based on important sensors. Robot can learn efficiently by reduced learning space.

Room E

GS29 Robotics V

Chair: Jiwu Wang (Beijing Jiaotong University, P. R. China)

GS29-1 Construction of a sense of force feedback and vision for micro-objects: Recreate the response and a sense of force of objects
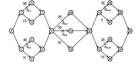
Tatsuya Domoto and Eiji Hayashi
(Kyushu Institute of Technology, Japan)

The purpose of this research was to develop a combined sense system that uses both force feedback and visual feedback to determine the shape of the microscopic features of a microsample. Efficiency in performing minute procedures would be improved if the operator could have a sense of force while using a manipulator. We used a cantilever to touch a minute object and obtain a reaction force from the degree of bending. We constructed a haptic device that gives a sense of that force to the operator when touching the sample with a cantilever. When the haptic device was used in simulations, the user could feel a force as if he had touched the sample.

January 20 (Friday), 08:40–09:40

GS29-2   Estimate of current state based on experience in POMDP for Reinforcement Learning

Yoshiki Miyazaki and Kentarou Kurashige
(Muroran Institute of Technology, Japan)

Recently, reinforcement learning (RL) attracts attention. Because interaction with environment is important on RL, it is necessary to recognize state of robots more accurate. However, in real environment there is incompleteness on recognition by ability lack and noise of sensors. If recognition has incomplete, there is problem that robots cannot learn appropriately because robots cannot distinguish states that robots should originally distinguish. The model including such incompleteness is known as POMDP and we aim to solve the problem learning does not progress appropriately in POMDP. We pay attention to the experience of robots. When robots cannot identify current state uniquely, robots decide current state using current observation, previous recognition state and action. And, by memorizing this state information as internal state, recognizable state increases. In this way, robots can distinguish states which robots cannot distinguish in conventional method and learn appropriately. We show the effectiveness of proposed technique with simulation.

GS29-3   Evolution of locomotion in a simulated quadraped robot and transferral to reality

Kyrre Glette[1], Gordon Klaus[1], Juan Cristobal Zagal[2], and Jim Torresen[1]
([1]University of Oslo, Norway)
([2]University of Chile, Chile)

In this paper, we study the suitability of using simulation in the evolution of locomotion in a quadruped robot. The goal of the evolution is to design a control system that produces fast gaits. We evolve gaits in simulation, and then the best controllers are transferred into the real custom built robot and compared with their simulated versions. The results show effective locomotion, with a 1.8 times improvement in speed over earlier results. Finally, we investigate some measures to reduce the difference between simulated and real locomotion.

GS29-4   A study on the use of tactile instructions for developing robot's motions

Fransiska Basoeki[1], Fabio DallaLibera[1], Takashi Minato[2], and Hiroshi Ishiguro[1]
([1]Osaka University, Japan)
([2]ATR Hiroshi Ishiguro Laboratory, Japan)

Developing motions for humanoid robots is a time consuming task. However, we note that sport or dance instructors can easily adjust their students' postures by simple touches. This suggests the possibility of exploiting touch for motion development, and allows us to propose a methodology based on this concept. This requires defining how the robot should interpret user's touches. We propose a supervised learning approach for coping this issue, and verify its feasibility experimentally. We then study the data collected by the algorithm, and show that the system is usable both for motion development and as a tool for studying human-robot tactile communication. In particular, considerations on the sparsity that characterize the whole process are presented, and policies for an efficient interpretation of tactile instructions are drawn.

January 20 (Friday), 08:40–09:40

Room F

OS9 Computer-Supported Learning Systems I

Chair: Kenneth J. Mackin (Tokyo University of Information Sciences, Japan)
Co-Chair: Daisuke Yamaguchi (Toin University of Yokohama, Japan)

OS9-1   The PSP low layer practice support used on the android personal digital assistant

Daisuke Yamaguchi[1] and Ayahiko Niimi[2]
([1]Toin University of Yokohama, Japan)
([2]Future University Hakodate, Japan)

Software architecture has emerged as an important sub discipline of software engineering. PSP support system is built using this. Moreover, We think that the data inputted can acquire software development process by sorting out using a user action record table. In this paper, the Personal Software Process (PSP) practice support system that we realize record-keeping support of flame work performing data acquisition of process flow offered in PSP in other Android carrying end with a software development environment using based on the Multiagent technologies. It is thought that we can tie that we come true with an Android mobile terminal when we perform the convenience that we don't affect to a software development environment and reference of a document if dated consciousness of flow. So, We can be conscious of process flow in every environment with development by this system can transmit programming to specific human among many software processes using Agent's technology.

OS9-2   Development of game based learning features in programming learning support system

Eiji Nunohiro, Kotaro Matsushita, Kenneth J Mackin, and Masanori Ohshiro
(Tokyo University of Information Sciences, Japan)

In this research, a programming learning support system incorporating game based learning is proposed. The aim of the game based learning approach is to stimulate and sustain the motivation of the learner during programming training. In the developed system, a puzzle solving interface to programming training and a competitive scoring system was implemented to incorporate game based learning. The proposed system was applied to an actual college programming course to verify the effectiveness of the proposed system. Finally, future works based on the results are discussed.

OS9-3   Visualization of satellite data for educational use

Kotaro Matsushita, Shun Koshikawa, Taito Endoh, Jong Geol Park,
Takashi Yamaguchi, Kenneth J. Mackin, and Eiji Nunohiro
(Tokyo University of Information Sciences, Japan)

Tokyo University of Information Sciences maintains and distributes MODIS (Moderate Resolution Imaging Spectroradiometer) data as part of the research output for Frontier project. We have published many studies using MODIS data and many other researchers use them for their researches. On other hand, it is possible to use MODIS satellite data, especially NDVI (Normalized Difference Vegetation Index) for education. But it is necessary to visualize the data clearly for many users. In this research, we proposed a method to visualize satellite data for education and processed real MODIS data using the proposed method.

January 20 (Friday), 08:40–09:40

OS9-4   Programming learning support system with competitive gaming using monitoring and nicknames

Masanori Ohshiro, Kotaro Matsushita, Kenneth J Mackin, and Eiji Nunohiro
(Tokyo University of Information Sciences, Japan)

The authors have developed a programming training system CAPTAIN (Computer Aided Programming Training And INstruction) and have applied the system in an actual programming course. In this training system, learners create programs similarly to solving a puzzle game as followsO. Each complete runnable program is fragmented randomly into a few lines by the system. Users must sort the lines as an original source program. The system compile the source program sorted by the user and check the correctness of it. In such a learning support system, it is important that the learner can view one's learning progress objectively. Furthermore, if the learning progress could be compared with those of other learners, competition will occur to stimulate the learner's motivation. In our previous paper, we proposed and implemented the real-time monitoring feature for the support system. The new system monitors the statuses of all students' progresses and evaluates their degrees of achievement and ranks them in real time and continuously. ...

January 20 (Friday), 11:10–12:40

Room D

GS11 Data mining II

Chair: Ikuo Yoshihara (University of Miyazaki, Japan)

GS11-1   Proposal of method to extract location-related words and to classify location-dependent information

Masaki Sakata and Hiroyuki Nishiyama
(Tokyo University of Science, Japan)

In this study, we collected and analyzed tweets on "Twitter" to classify information of categories related to the location to systematically provide information about the location. This method extracts keywords of a high occurrence ratio (location-related words) appearing in tweets from a set of tweets generated at one location. We hypothesized that tweets including location-related words (location-dependent information) contained information related to the location, and classified the information accordingly. This method enables classifying the information related to the location and providing it to users even from information without an address or location.

GS11-2   Advantages of flexible musculoskeletal robot structure in sensory acquisition

Shuhei Ikemoto, Yoichi Nishigori, and Koh Hosoda
(Osaka University, Japan)

Morphological computation is the concept for which a well-designed hardware can bear part of the computational cost required for robot's control and perception. So far, many musculoskeletal robots have been developed by taking inspiration from human's one and shown superior motion performances. The use of pneumatic artificial muscles (PAMs) has been the key to realize these high performance. Additionally, PAMs have the possibility of being used as sensors for environmental information because they are flexible and backdrivable. In this research, we focus on clarifying how PAMs can contribute to morphological computation of robots driven by these actuators. In particular, we propose an analysis method based on transfer entropy and apply this method to the experimental data acquired by a musculoskeletal robot that opens a door.

January 20 (Friday), 11:10–12:40

GS11-3   Trend awareness by value senses in home energy consumption

Jin Dai[1], Fei Wei[1], Shingo Aoki[1], Hiroshi Tsuji[1], and Shuki Inoue[2]
([1]Osaka Prefecture University, Japan)
([2]The Kansai Electric Power Co., Inc., Japan)

To save home energy, we have proposed indirect control based on awareness. One of issues for indirect control is to classify users based on their life style which affects on the transaction of energy consumption. Designing pair-wise comparison among six kinds of value senses (convenience, housework support, healthy life, secure living space, comfort, sustainable environment), this paper proposes the method how to make clusters and then how to clarify the features of cluster in the context of value senses. Using the responses for questionnaire, this paper also describes how the proposed method works.

Room E

GS17 Image processing II

Chair: Hyoungseop Kim (Kyushu Institute of Technology, Japan)

GS17-1   Visual IMU in Manhattan-like enviroments from 2.5D data

Sven Olufs and Markus Vincze
(Vienna University of Technology, Austria)

In this paper we presented a novel robust method for a visual IMU in manhattan-like environments i.e. the frequently observed dominance of three mutually orthogonal vanishing directions in man-made environments. Our approach is based on the idea of the separate estimation of the rotational and translational motion based on dense 3D and 2D features. We estimate the Manhattan-like structure by using an MSAC variant that estimates the Manhattan system directly from the 3D data. In contrast to other methods we use only the normal vectors of each voxel rather than estimating it indirectly using plane estimation. In a next step we estimate the translative motion of the robot relative to the Manhattan system using constrained visual odometry. Both rotational and translational motions are fused in a UKF. We show the robustness of our Manhattan-estimation using real world data. In this paper we demonstrate our approach using a Microsoft Kinect, while the approach will work with all kind of 2.5D sensors.

GS17-2   Image texture analysis using second order statistical model

Shahera Hossain and Seiichi Serikawa
(Kyushu Institute of Technology, Japan)

Image texture analysis is very crucial research topic for various vision-based applications. In this paper, robust gray-level co-occurrence matrix (GLCM)-based statistical model is explored and exploited for various image texture analysis. After demonstrating the model, experimental analyses are accomplished with datasets to demonstrate the performances of the statistical model. It illustrates that these statistical modules can be very much functional for image texture understanding.. Initially, we run our model in some ground-truth images covering few basic patterns, so that we can vividly compare the results on various images on datasets. The experimental dataset is the standard 'building surface dataset', where the experimental results relate the ground-truth data significantly.

January 20 (Friday), 11:10–12:40

GS17-3 Study on the development of the log scaling system based on the machine vision

Jiwu Wang[1], Weijie Gao[1], Fangbo Liao[1], and Sugisaka Masanori[2]
([1]Beijing Jiaotong University, P. R. China)
([2]Nippon Bunri University, Japan)

The conventional log scaling, which is measured with a ruler by manual operation in order to get higher precision, is carried on by more workers working hard for a longer time. With the new developed technique, it is possible to use the machine vision for the log scaling. In order to get satisfactory results for that scaling process, the distance between the log and camera should be measured accurately. At the same time, the environment conditions for image capture will be considered carefully. In this paper, the laser rangefinder is developed to determine the distance between the log and camera automatically. The log scaling based on the machine vision was developed, and its properties were tested with various experiments.

GS17-4 Arterial hemodynamic analysis on non-enhanced magnetic resonance angiogram using optical flow

Akiyoshi Yamamoto, Hyoungseop Kim, Joo Kooi Tan, and Seiji Ishikawa
(Kyushu Institute of Technology, Japan)

Peripheral arterial disease (PAD) is caused to the lower extremity atherosclerotic disease. Its diagnosis is needed to obtain much kind of the information of vascular morphology as well as the blood flow information based on hemodynamics. The diagnosis of the PAD using magnetic resonance imaging (MRI) equipment without contrast medium is available as a useful visual screening in clinical practice. In this paper, we propose a novel method for visualizing hemodynamics to arterial images obtained by a non-contrast enhanced magnetic resonance angiography (MRA) based on the Lucas-Kanade optical flow with the image pyramid processing, and satisfied experimental results are obtained.

Room F

GS23 Neural networks II

Chair: Jiann-Shing Shieh (Yuan Ze University, Taiwan)

GS23-1 Medical image diagnosis of liver cancer by feedback GMDH-type neural network using knowlege base

Tadashi Kondo, Junji Ueno, and Shoichiro Takao
(The University of Tokushima, Japan)

A revised Group Method of Data Handling (GMDH)-type neural network algorithm using knowledge base for medical image diagnosis is proposed and is applied to medical image diagnosis of the liver cancer. In this algorithm, the knowledge base for medical image diagnosis is used for organizing the neural network architecture for medical image diagnosis. Furthermore, the revised GMDH-type neural network algorithm has a feedback loop and can identify the characteristics of the medical images accurately using feedback loop calculations. It is shown that the revised GMDH-type neural network is accurate and a useful method for the medical image diagnosis of the liver cancer.

GS23-2 Large database analysis of out-of-hospital cardiac arrest using ensembled neural networks

Jiann-Shing Shieh[1,4], Yuan-Jang Jiang[1], Huei-Ming Ma[2], Wei-Zen Sun[2], and Guan-Wu Jang[3]
([1]Yuan Ze University, Taiwan)
([2]National Taiwan University, Taiwan)
([3]New Taipei City Government, Taiwan)
([2]National Central University, Taiwan)

The purpose of this study is to use seven different sensitivity analyses to find out the important variables to establish a comprehensive and objective assessment method. After pre-filtering, we obtained 4095 data for building this ensembled neural networks (ENN) model. The data has been divided into 60% data for training, 20% data for validation, and 20% data for testing. The eleven inputs, including response time, on-scene time, patient transfer time, time to cardiopulmonary resuscitation (CPR), CPR on the scene, using drugs, age, gender, using airway, using automated external defibrillator (AED), and trauma type, and one output variable have been selected as ENN model structure. The results have been shown CPR on the scene, using drugs, on-scene time, and using airway in the top four of these 11 important variables. Moreover, these four variables have also been shown significant differences when we use traditional one variable statistics analysis for these variables.
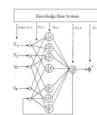
GS23-3 Analog circuit for detecting position of smell based on pheromone source location of silkmoth

Masaki Ihara and Kimihiro Nishio
(Tsuyama National College of Technology, Japan)

In this study, we proposed an analog complementary metal oxide semiconductor (CMOS) circuit based on the pheromone source location of the silkmoth. Since the proposed circuit consists of the smell sensor, five metal oxide semiconductor (MOS) transistors and four resistors, the proposed circuit is simple structure. The measured results of the test circuit fabricated on the breadboard showed that the output voltage becomes large when the smell sensor detects the smell of the target. The output voltage of the test circuit was approximately equal to the output signal of the model based on the pheromone source location of the silkmoth. The measured results showed that the proposed circuit can control the motor. In the future, the novel compact target tracking sensor can be achieved by applying the proposed circuits based on the pheromone source location of the silkmoth and the previous circuit based on the biological vision and auditory systems.

January 20 (Friday), 11:10–12:40

GS23-4   Discussion of stability of adaptive type neural network direct controller and its folding behavior

Takayuki Yamada
(Ibaraki University, Japan)

This paper discusses stability of an adaptive type neural network direct controller in the viewpoint of its folding behavior. First, I discuss the stability for the nonlinear plant and the nonlinear neural network. This discussion confirms that we can include the plant Jacobian problem into the tuning problem of the parameter determining the neural network learning speed. This is because it was confirmed that the direct controller has the folding behavior and the sign of the slope of a part of plant inverse characteristics learned by the neural network dose not change. This means that the sign of the plant Jacobian dose not change. Next, I assume input output relations of the neural network are linear and present the detail of the stability condition. This assumption may not be practical, but it is helpful for understanding of the relationship between the plant Jacobian and the parameter tuning.

GS23-5   A neural network strategy for process optimization

Shiu-Wan Hung
(National Central University, Taiwan)

Designing high-quality products/processes at low cost leads to increasing market share and gaining competitive advantage. Thermoforming of plastic sheets has become an important process in industry because of their low cost and good formability. However there are some unsolved problems that confound the overall success of this technique. Nonuniform thickness distribution caused by inappropriate processing condition is one of them. In this study, results of experimentation were used to develop a process model for thermoforming process via a supervised learning back propagation neural network. An "inverse" neural network model was proposed to predict the optimum processing conditions. The network inputs included the thickness distribution at different positions of molded parts. The output of the processing parameters was obtained by neural computing. Good agreement was reached between the computed result by neural network and the experimental data. Optimum processing parameters can thus be obtained by using the neural network scheme we proposed. This provides significant advantages in terms of improved product quality.

January 20 (Friday), 13:40–14:55
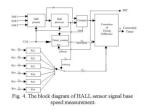
Room C

OS20 Intelligent Systems and Applications

Chair: Kuo-Lan Su (National Yunlin University of Science and Technology, Taiwan)
Co-Chair: Jie-Tong Zou (National Formosa University, Taiwan)

OS20-1   A correction circuit of Hall sensor signal base speed measurement for BLDC motors

Chung-Wen Hung, Jhih-Han Chen, and Ke-Cheng Huang
(National Yunlin University of Science and Technology, Taiwan)

A speed correction circuit is proposed in this paper, the speed measurement is based on Hall sensor signal. Brushless DC (BLDC) motors are more and more popular, and the Hall sensors are usually built in for commutation. The Hall sensors and poles of the rotor are supposed to be placed in uniform distance and angle, then Hall sensor signal feedbacks are also used to measure motor speed. However, there is misalignment, and what will cause the error of measurement. A method is discussed to estimate the error of misalignment, and the inaccuracy could be corrected by the proposed circuit. This circuit is based on the hardware description language and implemented in FPGA, and then the synthesizing simulation results are presented to prove this circuit is workable.

Fig. 4. The block diagram of HALL sensor signal base speed measurement.

OS20-2   An image sensor based virtual mouse including fingertip detection in face mask algorithm

Chung-Wen Hung, Hsuan T. Chang, and Cheng-Yang Chen
(National Yunlin University of Science & Technology, Taiwan)

An image sensor based virtual mouse with fingertip detection in face mark (FDIFM) function is proposed in this paper. As the image sensors or webcams are more and more cheap and popular, the algorithms are developed to detect the fingertip location and its motions. The motion information could be used to define the mouse functions and perform a virtual mouse. When the fingertip locates in the face area, it is difficult to detected, due to similar skin colors. The FDIFM algorithm is developed to handle this exceptional situation, using the red component image of the face area, the fingertip could be detected successfully. In this paper, the algorithms and simulation results are described, and the experimental results are also presented to verify the virtual mouse workable.

OS20-3   The modeling and implementation of tri-rotor flying robot

Jie-Tong Zou[1], Kuo-Lan Su[2], and Haw Tso[1]
([1]National Formosa University, Taiwan)
([2]National Yunlin University of Science & Technology, Taiwan)

The objective of this study is going to develop a tri-rotor flying robot, which adopts the Y-shaped three-rotor structure. In order to balance the yaw torque produced by the three rotors, it installs the RC servo motor and linkage on the tail axis, so as to improve the angle of the rolling axis of the tail motor. Moreover, through the torque generated by the horizontal component of the lift from the inclined motor on the tail axis, it balances the yaw torque of the three rotors. The dynamic equations of the tri-rotor flying robot were determined in this paper. The relationship between motor thrust, angular acceleration and voltage input were also studied in this research. In order to study the effect of control parameters on the flight stability completely, this study develops a universal stability experimental platform to help tuning the control parameters safely. Based on this, the tri-rotor flying robot can rapidly change flying gesture and avoid oscillation. Finally, we made some indoor and outdoor flight tests. From the experimental results, the tri-rotor flying robot can fly and hover stably in the sky.

January 20 (Friday), 13:40–14:55

OS20-4   Path planning of fire escaping system for intelligent building

Hsu-Shan Su and Kuo-Lan Su
(National Yunlin University of Science & Technology, Taiwan)

We present the path planning techniques of the fire escaping system using multiple smart mobile robots for intelligent building. The fire escaping system contains a supervised computer, an experimental platform, some fire detection robots and some navigation robots. These mobile robots have the shape of cylinder and its diameter, height and weight is 10cm, 15cm and 1.5kg, and contain a controller module, two DC servomotors (including drivers), three IR sensor modules, a voice module and a wireless RF module, and acquire the detection signal from reflective IR sensor through I/O pins, and receive the command from the supervised computer via wireless RF interface. The fire detection robot carries the flame sensor to detect fire sources. The supervised computer controls the fire detection robots to detect fire source moving on the grid based experiment platform, and calculates the more safety escaping path using piecewise cubic Bezier curve on all probability escaping motion paths on the user interface. Then the system uses A* searching algorithm to program escaping motion paths to approach to Bezier curve. ...

OS20-5   Speech based formation control of multiple mobile robots

Kuo-Lan Su, Bo-Yi Li, Jr-Hung Guo, and Chih-Hung Chang
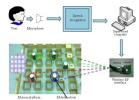(National Yunlin University of Science & Technology, Taiwan)

The article presents multiple pattern formation control of the multi-robot system using A* searching algorithm, and avoids the collision points of motion paths. We use speech recognition algorithm to control the variety pattern formations exchange, and use mobile robots to present the movement scenario on the grid based motion platform. We have been developed some pattern formations according to game applications, such as long snake pattern formation, phalanx pattern formation, crane wing pattern formation, sword pattern formation, cone pattern formation and so on. The mobile robot contains a controller module, three IR sensor modules, a voice module, a wireless RF module, a compass module, and two DC servomotors. The mobile robot can acquires the detection signals from reflect IR sensor modules and compass module, and decides the cross points of the aisle, and receives the command from the supervised compute, and transmits the status of environment to the supervised computer via wireless RF interface. We develop the user interface of the multi-robot system to program motion paths for variety pattern formation exchange on the minimum displacement. Users can use speech to control the multiple mobile robots to executed pattern formation exchange on step by step or continuously. …
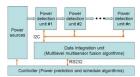
OS20-6   Development of the residual power prediction system of mobile robots

Jr-Hung Guo[1], Jie-Tong Zou[2], Kuo-Lan Su[1], and Cheng-Yun Chung[1]
([1]National Yunlin University of Science & Technology, Taiwan)
([2]National Formosa University, Taiwan)

The article presents a multiple residual power prediction system to be applied in mobile robots or automation fields. The system contains multiple power detection units to measure multiple on-line power values. Each power detection unit uses four current sensors to measure the current variety, and uses weighted average method and redundant management method to calculate the exact current value, and isolates faulty measurement values. We use the proposed algorithms to be applied in voltage detection of each power detection unit, too. Then we can calculate the real-time power values according to the current and voltage measurement values. The control core of the power detection unit is HOLTEK microchip, and communicates with the data integration unit via wire I2C interface. The power detection units transmit the measurement values of current and voltage to the controller of the system. The main controller of the power detection system is PC based system, and communicates with the data integration unit via wire RS232 interface. ...

January 20 (Friday), 13:40–14:55

OS20-7 **Development of tactile sensing system and evaluation for the application to the intelligent robot using the microbending fiber optic sensors**

Ju-Won Jeong[1], Heo-Jin Seok[2], and Jung-Ju Lee[1]
([1]Korea Advanced Institute of Science and Technology, Korea)
([2]Samsung Electronics company, Korea)

This paper describes the system design and the structural design to evaluate the tactile sensor using the microbending fiber optic (MBFO) sensors. The small light emitted diode (LED) and charge coupled device (CCD) are used as a single light source and a light detector for the bundle of optical fibers respectively. And the structure of this type tactile sensor which is composed of crossed fibers in the silicone rubber is very simple. And the tactile sensor element using MBFO sensor is fabricated and the performance of this sensor is evaluated.

Room D

GS7 Complexity

Chair: Reiji Suzuki (Nagoya University, Japan)

GS7-1 A potential model pruning in Monte-Carlo *go*

Makoto Oshima, Koji Yamada, and Satoshi Endo
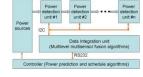(University of the Ryukyus, Japan)

In this study, we tackled the reduction of computational complexity by pruning the igo game tree using the potential model based on the knowledge expression of igo. The potential model considers go stones as potentials. Specific potential distributions on the go board result from each arrangement of the stones on the go board. Pruning using the potential model categorizes the legal moves into effective and ineffective moves in accordance with the threshold of the potential. In this experiment, 5 kinds of pruning strategies were evaluated. The best pruning strategy resulted in an 18% reduction of the computational complexity, and the proper combination of two pruning methods resulted in a 23% reduction of the computational complexity. In this research we have successfully demonstrated pruning using the potential model for reducing computational complexity of the go game.
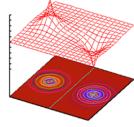
GS7-2 Emergence of autocatalytic reaction in a meme propagation model based on particle motion

Kengo Kobayashi, Reiji Suzuki, and Takaya Arita
(Nagoya University, Japan)

Meme refers to a unit of human cultural transmission, analogous to gene in biological evolution. Meme propagation has an autocatalytic property in the sense that it increases its reproductive rate by duplicating the source of propagation. The purpose of this study is to gain general knowledge about dynamics of meme propagation. This paper presents a minimal model based on physical movement of particles for investigating the relationship between the behavior of the hosts (velocity of particles) and the autocatalytic property of the meme. It is demonstrated that two extreme memes, the fastest and the slowest ones, have a strong tendency to survive by autocatalytic properties at individual and aggregate levels, respectively, although all memes seem neutral in terms of fitness in the model definition.

January 20 (Friday), 13:40–14:55

GS7-3   Pre-historical multiple movements of modern humans from Old World to Americas: Evidence based on comparing basic body-part name words with Austronesian

Koji Ohnishi
(Niigata University, Japan)

Basic body-part name vocabulary of representative Native American languages (NAmLs) and Eurasian languages was compared with ca. 1300 Austronesian (AN) basic words and with basic words of Eurasian languages. By applying closest similarity analysis of occurring frequencies of thus found AN cognates (of non-AN vocabulary) in subgroups of AN, NAmLs are concluded to have been derived from various branches of AN family, by human movements not only via Behring land-bridge but also via trans-Pacific sailing rout (as represented by Maipuran language in Amazonian area). Such independent human movements to Americas are concluded to be much more frequent than has been generally considered.

GS7-4   Bifurcation analysis in a silicon neuron

Filippo Grassia[1], Timothée Levi[1], Sylvain Saighi[1], and Takashi Kohno[2]
([1]University of Bordeaux, France)
([2]University of Tokyo, Japan)

In this paper, we describe an analysis of the nonlinear dynamical phenomenon associated with a silicon neuron. Our silicon neuron integrates Hodgkin-Huxley model formalism, including the membrane voltage dependency of temporal dynamics. Analysis of the bifurcation conditions allow us to identify different regimes in the parameter space that are desirable for biasing our silicon neuron. This approach of studying bifurcations is useful because it is believed that computational properties of neurons are based on the bifurcations exhibited by these dynamical systems in response to some changing stimulus. We describe numerical simulations and measurements of the Hopf bifurcation which is characteristic of class 2 excitability in the HH model. We show a phenomenon observed in biological neurons and termed excitation block. Hence, by showing that this silicon neuron has similar bifurcations to a certain class of biological neurons, we can claim that the silicon neuron can also perform similar computations.

1. Bifurcation diagram for our approximated model.

Room E
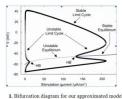
GS19 Intelligent control & modeling II

Chair: Nobuhiro Okada (Kyushu University, Japan)

GS19-1   Intelligent control method for autonomous vehicle by fuzzy-neural network and self-position-azimuth Correction

Ryunosuke Takauji, Peng Chen, and Mitushi Yamashita
(Mie University, Japan)

This paper proposes an Intelligent Control Method for Autonomous Vehicle which will roughly-appropriately and automatically recognize and judge the running environment and run along a given orbit without disarray by using Fuzzy-Neural Network (FNN). To realize autonomous running by using FNN, We extracted human's driving knowledge (teaching data for the FNN) from the running data. For acquiring the teaching data for the FNN, the running data are processed and normalized by rough set and defuzzy method. Moreover, we proposes an error correction method called "self-position-azimuth correction" to detect and correct the position and azimuth error between estimated position and actual measured position of the vehicle by using a pole at already-known position. The efficiency of the method has been verified by computer simulations and tests using a model vehicle.

January 20 (Friday), 13:40–14:55

GS19-2　Learning strategy with neural-networks and reinforcement learning for actual manipulator robot

Shingo Nakamura and Shuji Hashimoto
(Waseda University, Japan)

When the bottom-up learning approaches are implemented for mechanical systems, we must face a problem including huge number of trials. They take much time and give hard stress to the actual system. Simulator is often used only for evaluation of the learning method. However, it needs simulator modeling process, and never guarantees repeatability for the actual system. In this study, we are considering a construction of simulator directly from the actual robot with neural-networks. Afterward a constructed simulator is used for reinforcement learning to train a task, and the obtained optimal controller is applied to the actual robot. In this work, we picked up a five-linked manipulator robot, and made it track a ball as a training task. Both learning processes make load against the hardware sufficiently smaller, and the objective controller can be obtained faster than using only actual one.

GS19-3　A basic study on cooperative behavior of two butterflies inspired by quantum entanglement

Masaki Maezono[1], Ichiro Iimura[2], and Shigeru Nakayama[3]
([1]Kagoshima National College of Technology, Japan)
([2]Prefectural University of Kumamoto, Japan)
([3]Kagoshima University, Japan)

Recently, the physical concept of quantum entanglement has been introduced into the two distant insects (butterflies) to cooperatively find each other by the previous study of J. Summhammer. According to his experimental results, we have confirmed that the two butterflies with quantum entanglement may need as little as half of the flight path of independent butterflies to find each other. However, the case where the learning factor, the length of a short straight flight and the threshold of the scent intensity are different between two butterflies has not been clarified in his previous study. Hence we have simulated the cooperation of two butterflies while changing the condition of these parameters. This paper describes the experimental results. We aim at the optimum modeling of cooperative relation of two individuals as the first stage, and the contents in this paper deserve the initial experiment in the case of two distant butterflies which must find each other.

GS19-4　Importing dynamic planner to BDI agent creating flexible dicision-making of policies for selecting robot actions in real world

Megumi Fujita, Hiroko Katayama, Yuko Ojima, and Naoyuki Nide
(Nara Women's University, Japan)

Our aim is to create a more intelligent form of control for robots that can act autonomously for problem solving in the dynamic environments. The ability to select and modify the action decision policies to achieve the given goals in the most appropriate way as possible, and the easiest and most efficient way of implementation of such policy controls is required. We propose a flexible method for selecting policies of action decision in this paper, using a dynamic planner as the mechanism for determining the policies for action decision making. We proved through experimentation that when a robot cannot achieve its goal using a specific policy, it can modify the given policy to achieve that goal with the use of our method. In particular, for robots in the real world, the error of beliefs due to a false recognition of the sensors may be the reason why a robot cannot achieve its goal, although this situation will not come to light in any simulation. Our method is effective for such situations.

January 20 (Friday), 15:15–17:00

Room A

OS10 Computer-Supported Learning Systems II

Chair: Kenneth J. Mackin (Tokyo University of Information Sciences, Japan)
Co-Chair: Daisuke Yamaguchi (Toin University of Yokohama, Japan)

OS10-1 Educational effectiveness of the lecture using animated figures for beginner's programming course in the university

Yorinori Kishimoto and Kazuhisa Kitakaze
(Tokyo University of Information Sciences, Japan)

In education, lecture is required to use computer software such as PowerPoint, flash, and so on. One of the utilization purposes of this is education effect improvement. Usually, showing animated figures is said to be good for education. So, many education systems using animated figures have been proposed. However, only few attempts have so far been made at discussion of these effects. Especially, it has not been comparing the education system using animated figures with the chalk talk. So, we research effects of a lecture using animated figures. This is a comparative research of a lecture using animated figures and a chalk talk lecture in a beginner's programming education course of university. Students of beginner's programming education course have been divided into three groups. We focus on only two groups of these. One of the groups is shown program behavior by Microsoft PowerPoint animations and follows the program statements step-by-step and show changing values of program variables by abstraction figures. …

Fig. 3. Answer of question "Was the expression method plain for you?"

OS10-2 Self-learning support system to increase motivation for learning

Kei Ito, Tomoki Sato, and Ayahiko Niimi
(Future University Hakodate, Japan)

In higher education, a decline in the academic abilities of students has become a serious problem. In this paper, we propose a system to increase learning motivation with the ultimate aim to increase the academic ability of students. To achieve this aim, we provide an environment for students to facilitate self-e-learning system in classes using blended learning. We report the development of this environment and the results obtained.

OS10-3 A proposal of Web-Com API for e-learning contents creation services

Yoshihiro Kawano[1], Chao Zhou[2], and Tatsuhiro Yonekura[2]
([1]Tokyo University of Information Sciences, Japan)
([2]Ibaraki University, Japan)

This paper proposes Web-Com Service and Web-Com API. Web-Com Service enables to create/share easily multimedia learning contents on the Web. And, Web-Com API enable to access to the functions of Web-Com Service from other web sites by some program. Web-Com API provides as a web API for the usability. Web-Com API aims at the improvement in convenience of Web-Com service. The requirements of Web-Com API are "functions of Web-Com Service are available from other web sites", and "generation of a code for embedding the functions to other web sites". By realization of Web-Com API, the improvement in convenience of Web-Com service is expectable.

January 20 (Friday), 15:15–17:00

OS10-4   Using smartphones in sports education

Shinya Iwasaki, Kenneth J. Mackin, and Masahiro Ishii
(Tokyo University of Information Sciences, Japan)

Applying e-learning to hands-on education such as physical education has been difficult due to hardware and network restrictions in an out-of-classroom environment. In this research we propose using smartphones for sports education to improve the learning curve of athletes. There has been previous research reported on using carrier specific cellular phone applications for sports education. While the previous approach reported effectiveness on using mobile devices for education assistance, the carrier specific cellular phone approach had functional and interface limitations due to the hardware restrictions. For this research, we developed a Google Android application for sports education, namely track and field use, to support both the learner (athlete) and the educator (trainer). For the proposed application, we made use of the touch panel feature of Android hardware to facilitate data entry for the users. Validity of the proposed system was verified through experiment.

OS10-5   A vision-based motion-speed instruction method - Application to motion learning of underarm throw

Akinobu Morikawa, Ryota Sakamoto, and Yoshihiko Nomura
(Mie University, Japan)

When we learn our body motions with the physical exercises such as dances and sports, The learner, by him/herself, shall evaluate the correctness of the imitation in his/her movements. Therefore, we have developed a human-interface for instructing motions instead of instructors. The system was implemented with two functions. The first function is to evaluate the learner's movements. The second function is to correct the learner's motion using visual information. With these two functions, the learner can learn highly skilled motions in sports and dances by oneself. However, when instructing dynamic motions, we have to take into considerations not only postures but also speeds and accelerations. In this paper, aiming at providing a solution for the kind of motion speed instruction tasks, we proposed a vision-based system that is specifically designed for showing motion speed information to learner, and applied to an underarm ball throwing action. That is, while throwing before release, based on the online motion information, i.e., the velocity and position, the system predicts the after-release ball trajectory, and shows the trajectory to the learner in real-time. …

January 20 (Friday), 15:15–17:00

Room B

OS13 Embracing Complexity in Natural Intelligence

Chair: Yoshiteru Ishida (Toyohashi University of Technology, Japan)
Co-Chair: Koji Harada (Toyohashi University of Technology, Japan)

OS13-1   An analysis of spatial patterns in a spatial prisoner's dilemma

Yuji Katsumata and Yoshiteru Ishida
(Toyohashi University of Technology, Japan)

In the natural world, cooperative behavior emerges and assumes the crucial roles. Cooperative behavior means altruistic behavior and non-cooperative behavior (defection) means selfish behavior. Although cooperators emerge in the society, cooperation has not any advantage as compared to defection in rational terms. Earlier studies proposed many mechanisms to fill a gap between theoretical prediction and experimental evidence. As previous works, the authors studied the SPD that is spatial-temporal version of the Prisoner's Dilemma to investigate the maintenance mechanisms of cooperators. Then we observed a membrane formation as a mechanism that protects cooperation from invasion of defectors. The authors consider the effects of the interaction distance on the game payoff. In the present model, interacting with distant individuals pays a higher cost than interacting with adjacent individuals. In the SPD simulation, this paper shows that cooperators emerge easier by considering the effects of the interaction distance.

OS13-2   Identifying cellular automata rules using local rule network from spatiotemporal patterns

Takuya Ueda and Yoshiteru Ishida
(Toyohashi University of Technology, Japan)

There are some methods of Identifying rules of cellular automata (CA) from their spatiotemporal patterns. But these methods do not consider relations of local rules. The relations include spatial ones and temporal ones. For example, a rule which satisfy the mass conservation law has spatial constraints for how to apply local rules to each cells. A local rule network represents spatial or temporal associations between local rules which are identified from spatiotemporal patterns. This paper address to construct local rule networks from spatiotemporal pattern and propose rule identification methods using the networks.

ASEP   General PCA

OS13-3   Performance evaluations of adaptive strategies in self-repairing network
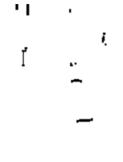
Masahiro Tokumitsu and Yoshiteru Ishida
(Toyohashi University of Technology, Japan)

This paper studies a relationship between an adaptive strategy and its payoff. In a recent study, the adaptive strategy has already proposed to evaluate how much the strategy obtains a payoff on average against not only itself but also other strategies. We study the adaptive strategy in two examples: a prisoner's dilemma and self-repairing network. We study the prisoner's dilemma by focusing on two parameters: benefit and cost. We reveal a condition when the strategy gets the highest adaptive measure against other strategies in the prisoner's dilemma game. Further, we apply the analysis to the self-repairing network with spatial strategies. We investigate the adaptive strategy in the self-repairing network by simulations. We revealed that the adaptive strategies get the high payoff which minimize the standard deviations in the simulations.

January 20 (Friday), 15:15–17:00

OS13-4   Solar Insolation simulation by cellular automata and applications to smart home

Ken Matsuka and Yoshiteru Ishida
(Toyohashi University of Technology, Japan)

Solar insolation influences important factors such as the indoor sunshine and room temperature. For a smart house, the amount of power generation of a photovoltaic generation depend on the solar insolation. However, knowledge required to evaluate the influences may not be readily available. We aim to build a solar insolation simulator that can be used without professional knowledge and detailed information. The simulator has simplicity and flexibility of a computational model of cellular automata. The advantage of this simulator is in an easy setup. Since this simulator needs only a floor plan diagram, its detailed knowledge is unnecessary. Moreover, the merit of the application by having created by the cellular automaton is also an advantage of this simulator.

OS13-5   Toward development of a strategy to drive HIV-1 into self-extinction through the error catastrophe

Koji Harada and Yoshiteru Ishida
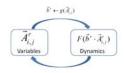(Toyohashi University of Technology, Japan)

The present study examines a possibility of new AIDS treatment without using anti-HIV-1 drugs to avoid drug resistance. Our idea originated in Eigen is by inducing excess mutations to HIV-1 genome, to drive HIV-1 population to destruction. Namely, we use the high mutation rate of HIV-1 as an underhanded way.
Our study proposes a novel HIV-1 mathematical model considered viral kinetic processes such as mutation, replication, infection and an action of a mutagen to control HIV-1 mutation rate. Through some model simulations by computer it reports to drive HIV-1 population to the error catastrophe by increasing HIV-1 mutation rate.

OS13-6   A pattern formation mechanism of a cellular automaton evolving on a mutual determination rule of variables and a dynamics

Koji Harada and Yoshiteru Ishida
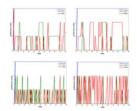(Toyohashi University of Technology, Japan)

The present study has an interest on complexity produced by removing the original boundary between different classes of concepts and it removes a boundary between a state variable and its dynamics by interacting them circularly on a two dimensional cellular automaton. It clarifies that removing the boundary creates the complexity of changing simple periodic orbits into attractive ones and proves a theorem about a period which characterizes periodic behaviors observed in simulations.
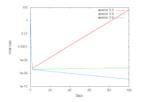
OS13-7   Network rewiring in self-repairing network: from node repair to link rewire

Yoshiteru Ishida and Kei-Ichi Tanabe
(Toyohashi University of Technology, Japan)

Among self-action networks: self-recognition network and self-repairing networks, the self-repairing network allows the state change of nodes as a result of action (repair). The self-repair network is extended to allow network change as a result of action (rewire). Self-rewiring algorithm is also extended from the self-repairing algorithm. The extended algorithm can be applied to several problems such as stable marriage problem and distance adjustment problem. Comparison between node repair and link rewire as well as further extension will be discussed.

January 20 (Friday), 15:15–17:00

Room C

OS19 Intelligent System and Control

Chair: Kuo-Hsien Hsia (Far East University, Taiwan)
Co-Chair: Yen Liang Yeh (Far East University, Taiwan)

OS19-1   Obstacle avoidance control of indoor patrol robots using image-sensing techniques

Kuo-Hsien Hsia[1], Shao-Fan Lien[2], Juhng-Perng Su[2], and Wei-Cheng Lin[2]
([1]Far East University, Taiwan)
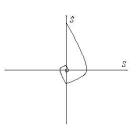([2]National Yunlin University of Science & Technology, Taiwan)

The wheel robot is one of the very popular research topics. Applications of wheel robots include security, searching and rescue tasks in the indoor environment. In this paper, the image-sensing techniques, including an image system and a laser range finder, are used for obstacle avoidance and environment identification. The image system could provide 2D information of indoor environment, and the depth information is provided from the laser range finder. Therefore the 3D environment can be reconstructed and the position of the robot can be obtained. The moving paths of robot are automatically real-time regulated with 3D environment information. Moreover, a monitoring station is proposed for supervising the robot. The display of the station includes the laser range finder display and real-time video. In the experimental results, the 3D environment information is displayed on station and the robot can indeed avoid the obstacles in the indoor environment automatically.

OS19-2   Twisting algorithm second order sliding mode control for a synchronous reluctance motor

Wen-Bin Lin, Huann-Keng Chiang, and Yi-Chang Chang
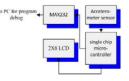(National Yunlin University of Science & Technology, Taiwan)

This paper shows the design of a twisting algorithm second order sliding mode controller (SOSMC) for a synchronous reluctance motor. The second order sliding mode control is an effective tool for the control of uncertain nonlinear systems since it conquers the main shortcomings of the conventional sliding mode control, namely, the large control effort and the chattering effect. Its theory implies simple control laws and assures an improvement of the sliding accuracy with respect to conventional sliding mode control. This paper proposes a novel scheme that based on the technique of twisting second order sliding mode control. First, the SOSMC is obtained by mathematics. Finally, the proposed method is verified by simulation. The proposed SOSMC shows the robustness for the motor parameters variation and the development of chattering effect.

OS19-3   The implementation of accelerometer and embedded system-based multi-functional pedometer

Yi-Yu Lu[1,2], Kuo-Sheng Cheng[1], Wen-Bin Lin[2,3], and Ji-Jer Huang[4]
([1]National Cheng Kung University, Taiwan)
([2]Far East University, Taiwan)
([3]National Yunlin University of Science & Technology, Taiwan)
([4]Southern Taiwan University of Technology, Taiwan)

Pedometers are known to have steps estimation issues. This is mainly attributed to their innate acceleration based measuring sensory. In this work, purposes a novel implementation of microcontroller and accelerometer sensor- based for multi-function pedometer in calorie consumption calculation. To verify the output voltage stability of accelerometer sensor, the methods of statistics analysis is introduced to extract the useful features. Three kinds of different steps are employed to obtain the analytic data. The proposed pedometer dimension of a proto-type is 68 mm(L) X 42 mm(W) X 15 mm(H).

January 20 (Friday), 15:15–17:00

OS19-4　An efficient three-scan approach for mining high utility itemsets

Guo-Cheng Lan[1], Tzung-Pei Hong[2,3], and Vincent S. Tseng[1]
([1]National Cheng Kung University, Taiwan)
([2]National University of Kaohsiung, Taiwan)
([3]National Sun Yat-Sen University, Taiwan)

Utility mining finds out high utility itemsets by considering both the profits and quantities of items in transactions. In this paper, a three-scan mining approach is proposed to efficiently discover high utility itemsets from transaction databases. The proposed approach utilizes an itemset-generation mechanism to prune redundant candidates early and to systematically check the itemsets from transactions. Finally, the experimental results on a synthetic dataset show the superior performance of the proposed approach.

OS19-5　Thermal wave effect for living tissue with surface heating problems by differential transformation method

Song-Yih Lin[1,2], Hsin-Yi Lai[1], and Cha'o-Kuang Chen[1]
([1]National Cheng Kung University, Taiwan)
([2]Far East University, Taiwan)

The Pennes' bio-heat conduction equation is common used to simulate temperature distribution for bio-heat transfer problems, it adopted the classical Fourier heat conduction law that is obviously incompatible with physical reality when research on microscopic heat transfer, low-pressure gases, cryogenic engineering, etc. Applying the concept of finite heat propagation speed, a thermal wave model of bi-heat transfer has developed. In order to analyze the thermal wave effect on temperature distributions, the different boundary heating conditions are considered with thermal wave model of bi-heat transfer and also compare to the Pennes'. The differential transform method combined with the finite difference scheme is proposed to simulate the temperature distributions. From results show it takes a period of time for the surface heating to propagate to a desired point inside the living tissue by the effect of thermal wave.

OS19-6　The forming parameter analysis of the circular plate by using computer-aided engineering

Yen-Liang Yeh, Kuo-Ying Chen, and Chia-Hsing Shen
(Far East University, Taiwan)

This paper is investigation of the effect of the large deformation on the forming parameter for the circular plate forming. This analysis tool of this paper is the ANSYS LS DYNA software. The forming parameter of the paper includes the punching velocity and die material property. From the analysis result, this can be known the variable result can be got under the differential parameter condition. When the punching velocity is increasing, the extrusive material will appear. When the die material strength increase, the forming thickness of the forming shape becomes small. When the deform velocity of the die material is increasing, the forming thickness of the forming shape becomes small. Therefore, the effect of the die material effect on the thickness of the forming shape is very clear. This analysis tool can effectively predict the forming shape.

January 20 (Friday), 15:15–17:00

OS19-7   Motion planning using memetic evolution algorithm for network robot systems

Chien-Chou Lin, Wei-Ju Chuang, and Kun-Cheng Chen
(National Yunlin University of Science and Technology, Taiwan)

A hierarchical memetic algorithm (MA) is proposed for the path planning of swarm robots. The proposed algorithm consists of a global path planner (GPP) and a local motion planner (LMP). The GPP plans a trajectory within the Voronoi diagram (VD) of the free space. An MA with a non-random initial population plans a series of configurations along the path given by the former stage. The MA locally adjusts the robot positions to search for better fitness along the gradient direction of the distance between swarm robots and intermediate goals (IGs). Once the optimal configuration is obtained, the best chromosomes are reserved as the initial population for the next generation. Since the proposed MA has a non-random initial population and local searching, it is more efficient and the planned path is faster than the traditional genetic algorithm (GA).

Room E

OS24 Medical Science and Complex Systems

Chair: Ken Naitoh (Waseda University, Japan)
Co-Chair: Takashi Matsuo (Kanagawa Institute of Technology, Japan)

OS24-1   Hyper-gourd theory: solving simultaneously the mysteries in particle physics, biology, oncology, neurology, economics, and cosmology
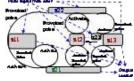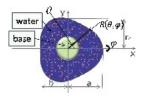
Ken Naitoh
(Waseda University, Japan)

The inevitability of various particle masses for hadrons, quarks, leptons, atoms, biological molecules, droplets of fossil fuel and water, living cells including microorganisms and cancers, multi-cellar systems such as organs, neural systems, and the brain, stars, galaxies, and the cosmos is synthetically revealed. This is possible because each flexible particle is commonly generated by a mode in which a larger particle breaks up into two smaller ones through a gourd shape with two lumps. These masses, sizes, frequencies, and diversity dominated by super-magic numbers including the silver ratio, in fractal nature can be derived by the fusion of the quasi-stability principle defined between absolute instability and neutral stability, the indeterminacy principle extended for quantum, statistical, and continuum mechanics, and the spherical Lie group theory. The analyses also result in a new mathematical definition of living beings and non-living systems and further explain the standard network patterns of various particles and also the relation between information, structure, and function, because the proposed theory based on gourds posits a new hyper-interdisciplinary physics that explains a very wide range of scales, while the Newton, Schrodinger, and Boltzmann equations describe only a narrow range of scales.

OS24-2   Quasi-stability: Revealing the inevitability of biological molecules

Hiromi Inoue, Kenji Hashimoto, and Ken Naitoh
(Waseda University, Japan)

Living beings meta-stable between unstable and neutral-stable conditions use only five types of nitrogenous bases and twenty amino acids selected naturally. The quasi-stability principle derived for spheroid particles [Naitoh, JJIAM 2001, Artificial Life Robotics 2010, Naitoh et al. Artificial Life Robotics 2011] reveals the reason why the molecular weight of purines and pyrimidines among nitrogenous bases varies by only about 1.5 times, whereas the threefold variation for the molecular weights of amino acids. Here, the theoretical model extended for the various levels of van der Waals force, surface tension, and coulomb force reveals the inevitability of proteins having the size ratios over 3.0. Moreover, we will also show the theoretical considerations for the other shapes of particles except for spheroids.

January 20 (Friday), 15:15–17:00

OS24-3 BioCell print utilizing PELID (Patterning with Electrostatically-Injected Droplet) method

Shinjiro Umezu
(Tokai University, Japan)

The object of this study is to fabricate three Dimensional cell structures utilizing PELID (Patterning with ELectrostatically-Injected Droplet) method. Because it is preferable to perform laboratory experiments with 3D cell structures in tissue engineering and artificial organ. However, it is difficult to fabricate 3D cell structures because own weight of cell is above the bonding force between cells. In this paper, we printed MDCK cells and collagen as scaffolds utilizing the PELID method. We investigated growth of printed cells. Number of printed cells was increased day by day. We investigated fundamental character-istics on patterning collagen. The printed collagen was thick when the time to print was increased. These results indicated that it is possible to fabricate 3D cell structure.

OS24-4 Collective motions of Chases and Escapes

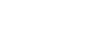Toru Ohira
(Sony Computer Science Laboratories, Inc., Japan)

We review here a new theme of one group chasing another, called "group chase and escape" by presenting simple models. We will show that even a simple model can show rather rich and complex behavior. The model is extended to investigate the effects of (1) fluctuations in taking steps of chasing and escaping, (2) reaction delays in chasing, (3) conversion of caught escapee to chasers. We show that these effects can bring in further complexity and rather unexpected behaviors.

OS24-5 Form and function of arterial bifurcations in the various parts of animal body

Takashi Matsuo[1], Shin-ichi Watanabe[1], Masato Nakakubo[1], Hidenobu Takao[1], and Tatsuhisa Takahashi[2]
([1]Kanagawa Institute of Technology, Japan)
([2]Asahikawa Medical College, Japan)

Arterial casts from animal brain, kidney, and ear as well as chorioallantonic arteries of chick embryo were subjected to the microscopic measurement of arterial geometry. According to the optimization principle known as Murray's law, the blood vessel geometry at a bifurcation satisfies the relation $D0^m = D1^m + D2^m$ (m=3), where D0, D1, and D2 are the diameters of the parent and two daughter vessels, respectively. The values of diameter exponent m were found to be 2.59 for brain, 2.54 for kidney, 2.58 for earlobe, and 2.49 for chick embryo, showing significant deviation from the Murray's law. Physiological implication of m values is discussed.

January 20 (Friday), 15:15–17:00

Room F

GS15 Human-welfare Robotics

Chair: Takayasu Fuchida (Kagoshima University, Japan)

GS15-1   Development of the electric wheelchair hands-free semi-automatic control system using the surface-electromygram of facial muscles.

Yuki Yamashita, Hiroki Tamura, and Koichi Tanno
(University of Miyazaki, Japan)

The goal of Human-Computer Interface research is to provide humans with a new communication channel that allows translating people's intention states via a computer into performing specific actions. This paper presents a novel hands-free control system for controlling the electric wheelchair, which is based on Bio-signals as surface electromyogram signals. The Bioelectric signals are picked up from facial muscles then the Bio-signals are passed through an amplifier and a high pass filter. Motion control commands (Forward, Left, Right, Forward to the Right, Forward to the left and Stop) are classified by simple rule. These commands are used for controlling the electric wheelchair. However, it is difficult to safety control and fine control using the biological signal only. In addition, we introduce the semi-automatic control system using the laser range scanner. In this paper, we report the introduction of our proposal systems and our experimental results.

GS15-2   Upper extremity prosthetics: current status, challenges and future directions

Sanjaya Vipula Bandara[1], Ruwan Chandra Gopura[1], Manjula Udayanga Hemapala[1], and Kazuo Kiguchi[2]
([1]University of Moratuwa, Sri Lanka)
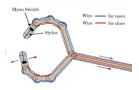([2]Saga University, Japan)

There is a drastic increment of the demand for prosthetic devices over the last few decades. This is caused by the increased amputees because of casualties due to civil wars, injuries due to accidents, etc. Therefore, the robotic prostheses are one of the highly interested research areas in recent robotic research. The target is to make sure the amputee gets a better chance to interact with the real world, in spite of the amputation he has. The paper presents the results of a comprehensive literature analysis towards a development of an upper-limb prosthetic arm. This study identifies the methods of prosthetic classification as the segment of application, number of degrees of freedom (DoF), types of applied actuators, types of power transmission methods and control methods. In this study, the upper extremity prosthetic devices are classified based on the segment of application. Thus, they can be mainly classified into shoulder prosthetics, transhumeral and elbow prosthetics, transradial and hand prosthetics. ...

GS15-3   Wire-driven two fingers robotic hand for operating a touch-sensitive panel

Tatsuro Hakui[1], Yukiharu Yamauchi[1], Sei-ichiro Kamata[2], and Shinnosuke Nakao[2]
([1]Kitakyushu National College of Technology, Japan)
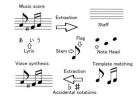([2]Waseda University, Japan)

We developed a robotic system named Ninomiya-kun. It is a humanoid whose head that is equipped with two cameras, and it can communicate with humans via sounds voice and gestures. The image of a printed document, such as a picture book, textbook, or magazine, each of which has a large number of characters, is captured by the cameras, and the characters are extracted from the captured image. Using a built-in computer with character recognition software, the robot translates the extracted characters into spoken words, which are produced by a voice synthesizer. In this paper, we propose a wire-driven robotic hand system for the operation of tablet computers and electronic book readers. It has two fingers, each of which has a wire-driven region and a touch pen at the fingertip for operating touch-sensitive panels. We describe the system configuration and wire-driven architecture herein.

GS15-4   Development of a singing robotic system from music scores in real time

Shou Imamoto[1], Yukiharu Yamauchi[1], Sei-ichiro Kamata[2], Naoto Ohta[2], and Yusuke Murayama[2]
([1]Kitakyushu National College of Technology, Japan)
([2]Waseda University, Japan)

In this paper, we propose a novel robotic entertainment system that can read a musical score and sing a song in real time. The objective of this system is to provide on-demand entertainment to onlookers. Previously, we developed a robotic system in collaboration with the Graduate School of Information, Production and Systems, Waseda University, and Shanghai Jiao Tong University. This system, named Ninomiya-kun, can read a book. It is equipped with a camera to read printed material placed on a book stand. In this study, we attempt to realize a robotic system that can sing a song by producing human-like sounds on the basis of notes and words extracted from a music score. Experimental results show that the proposed technique consistently outperforms well-established procedures.

GS15-5   Robotic system for reading Japanese characters on a written document in real time

Narumi Habu[1], Yukiharu Yamauchi[1], Sei-ichiro Kamata[2], Youhei Shinfuku[2], and Takahiro Kawabuchi[1]
([1]Kitakyushu National College of Technology, Japan)
([2]Waseda University, Japan)

This paper presents a robotic system in which a robot reads a printed document in Japanese. Currently electronic book readers are stimulating the electronic book market. These are, essentially smaller versions of personal computers and can be used to send emails, watch movies, or play games. We have developed a robotic system called Ninomiya-kun that has the ability to read a book. This robotic system is the size of a child and has an appearance resembling a human being. The robot is equipped with two cameras as part of a visual information processing mechanism and can communicate with humans via voice and gestures. It automatically extracts character areas that contain Japanese characters, which are recognized using character recognition procedures. The system configuration is described, as well as the Japanese character recognition procedures performed by the robot. The experimental results are also discussed.

GS15-6   Eye gesture controlled intelligent wheelchair using electro-oculography

Satish Ravishankar[1], Govinda Ram Pingali[1], Niyanth Krishna Polisetty[1], Theja Ram Pingali[1], Padmaja K.V[1], and Avinash Sista[2]
([1]R.V. College of Engineering, India)
([2]Mahindra Satyam, India)

This paper describes the design and implementation of an eye-gesture controlled electric wheelchair using the technique of Electro-Oculography. This is designed to be used as an intelligent mobility aid for the paralyzed which has features such as tilt detection, obstacle sensing, avoidance and path re-routing. The design employs an embedded control module that processes the bio-electric signals generated by the eye movements to actuate real world events. A microcontroller is used in place of a laptop computer, as the decision making entity, thereby making this an affordable solution. Various safety features are integrated using the control module to make a robust and optimized model.
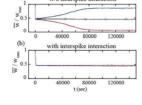
January 21 (Saturday), 08:40–10:10

Room A

GS6 Brain science

Chair: Timothée Levi (University of Bordeaux, France)

GS6-1 Correlation-based competition regulated by nonlinear interspike interaction in STDP

Shigeru Kubota
(Yamagata University, Japan)

The development of visual cortical circuits is strongly influenced by the sensory experience during a restricted critical period, as demonstrated by the loss of neural responses to the eye that has been briefly deprived of vision. It has been suggested that to reflect the sensory experience into the pattern of synaptic weights, the competition between groups of correlated inputs to an identical postsynaptic cell is essential and that spike-timing-dependent plasticity (STDP) may provide the basis of this type of correlation-based competition. To predict the consequences of competition by STDP in natural physiological conditions, I here investigate the effects of nonlinear interspike interaction in STDP that is experimentally observed in the visual cortical cells. The simulations show that the interspike interaction can prevent the induction of competition and counteract the effect of activity-dependent feedback (ADFB) that facilitates competitive functions. However, once the competition occurs, the level of competition is not affected by the interspike interaction. …

GS6-2 Density map of attentional capacity allocation

Satoshi Kambara[1] and Shigeyuki Oba[2]
([1]Kyoto University, Japan)
([2]Japan Science and Technology Agency, Japan)

Allocation of attentional capacity is an important consequence of visual attention, but its psychophysical mechanism has not been understood very well. We, in this study, investigate a procedure to estimate a high-resolution density map of the attentional capacity allocation on a visual field by analyzing a set of cognition performances on randomly located tasks. We propose a logistic regression model with multi-scale basis functions in order to achieve high-resolution density map, and an experimental scheme with different sizes of square shaped regions of attractors. Our preliminary results on two subjects showed that the corresponding shapes of attentional capacity allocation were different from those of the attractors which may reflect a hidden allocation mechanism of computational resource in brain.

GS6-3 Development of a brain computer interface using inexpensive commercial EEG sensor with one-channel

Masanao Obayashi, Kouji Watanabe, Takashi Kuremoto, and Kunikazu Kobayashi
(Yamaguchi University, Japan)

Brain Computer Interface (BCI) is a system to connect brain of human and computer in order to realize a though of human. In recent years, many such interfaces have been researched and applied for practical applications. Up to now, BCI systems, which have already applied practically, use expensive and large devices to measure the electroencephalographs(EEG). They are for almost all of users to be used for medical treatments. As a result, the BCI systems can't get the popularization to use easily. So, subjects of this study are construction of a BCI system using inexpensive commercial EEG sensor with one-channel, and investigation of the ability to apply it for utilization in various way. In this paper, using the methods of analyses for EEG that have already existed or have improved, we show that the BCI system using inexpensive commercial EEG sensor with one-channel is also useful.
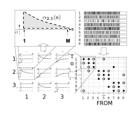
GS6-4   A sparse regression method to estimate neuronal structure from spike sequence

Syunsuke Aki[1], Shigeyuki Oba[1,2], Ken Nakae[1], and Shin Ishii[2]
([1]Kyoto university, Japan)
([2]Japan Science and Technology Agency, Japan)

Recent imaging techniques enable us to observe activities of hundreds of neurons simultaneously as spike sequences. The objective of this study is to estimate the network structure based on such spike sequences. Our method is an extension of existing sparse regression technique, in which we have implemented the following three ideas: (1) Each spike time-series obeys a non-stationary Poisson process whose Poisson intensity is given by an auto-regression model. (2) Spike response functions are represented by a linear summation of smooth basis functions. (3) A group-LASSO regularization is applied to obtain a sparse regression solution. When applied to simulation datasets, our method showed a better estimation performance than that by an existing state-of-the-art method.

Room B

OS1 Advanced Vehicle Control

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

OS1-1   Flight guidance and control of a winged rocket

Tomoaki Shimozawa, Shinichi Sagara, Tomohiro Narumi, and Koichi Yonemoto
(Kyushu Institute of Technology, Japan)

Since Reusable Launch Vehicles (RLVs) operate in a wide range of flight conditions, the values of the parameters of the RLVs' dynamic equations are not constant. Then some adaptive control methods for the RLVs' have been proposed and digital control systems are suited for digital computers. But the control performance decreases when the nonlinearity strengthens though a linear adaptive control has an excellent performance when the nonlinearity of the controlled system can be disregarded. In this presentation, We have proposed a digital adaptive feedback linearization control method with time-scale separation to a winged rocket. In this paper, we propose a digital adaptive feedback linearization control method using unscented Kalman filter. The simulation results with a guidance using genetic algorithm show the effectiveness of the proposed control systems.

OS1-2   Position and attitude control of underwater vehicle-manipulator systems using a stereovision system

Akihito Shigetomi, Shinichi Sagara, and Tomoaki Shimozawa
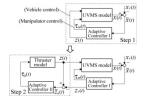(Kyushu Institute of Technology, Japan)

Underwater Vehicle-Manipulator Systems (UVMS) are expected to make important roles in ocean exploration. The manipulator operations in underwater need information of position between an object of capture and the vehicle. Therefore, sensors that measure position and attitude of the objects must be mounted on UVMS. We have been developing a stereovision system for UVMS. In this paper, to verify the effectiveness of the proposed stereovision system equipped to a floating UVMS, experiments on position and attitude control of the UVMS are done.

January 21 (Saturday), 08:40–10:10

OS1-3   Adaptive control of underwater vehicle-manipulator systems using radial basis function networks

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

This paper deals with a control scheme for underwater vehicle-manipulator systems with the dynamics of thrusters in the presence of uncertainties in system parameters. We have developed a regressor-based adaptive and a robust controller that overcome thruster nonlinearities, which cause an uncontrollable system. However, the structure of the adaptive controller is very complex due to the feedforward terms including the regressors of dynamic system models, and the error feedback gains of the robust controller with a good control performance are excessively high due to the lack of feedforward terms. In this paper we develop an adaptive controller that uses radial basis function networks instead of the feedforward terms. The replacement leads to a moderately high gain controller whose structure is simpler than that of the regressor-based adaptive controller.

OS1-4   An improved adaptive controller in the presence of input saturation - In case of systems with available output derivatives up to the order of relative degree -

Natsuki Takagi[1] and Masahiro Oya[2]
([1]Miyakonojo National College of Technology, Japan)
([2]Kyushu Institute of Technology, Japan)

We have proposed a model reference adaptive control scheme (conventional control scheme) for continuous time single-input single-output linear systems with an input saturation in which i-th derivatives of the output signal (i=1,..., relative degree) are available. In the conventional scheme, a condition for the initial states of the controlled object has to be satisfied. In this paper, the main attention is focused on the relaxation of the condition. To achieve the objective, we propose an improve adaptive control scheme. As a result of analyzing stability of the closed loop system using the improved adaptive control scheme, a new condition for the initial states is derived. It should be emphasized that we can apply the new control scheme in a larger region of initial states compared with the conventional one.

OS1-5   Development of a position control scheme for rotating sensor unit attached to in-pipe robot

Hdeki Wada[1], Masahiro Oya[2], and Katsuhiro Okumura[3]
([1]Sin-Nippon Nondestructive Inspection Co., Japan)
([2]Kyushu Institute of Technology, Japan)
([3]Fukuoka Industrial Technology Center, Japan)

In this paper, we propose a position control scheme for the rotation axis of a rotating ultrasonic sensor unit with a position adjustment mechanism. The control objective is that the position of the rotation axis can become equal to the center of a pipe. To realize the control objective, we provide a method to measure the vertical and horizontal position of the rotation axis. Using the measurements, we propose a position controller for the rotation axis. By carrying out experiments, we investigate the usefulness of the developed mechanism and the proposed position controller. As a result, it is shown that the proposed position control scheme has good performance.

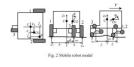## January 21 (Saturday), 08:40–10:10

OS1-6 Adaptive oscillation control scheme for a wheeled mobile robot

Bo Zhou, Tasuku Eto, Hiroshi Shibata, and Masahiro Oya
(Kyushu Institute of Technology, Japan)

In the case when wheeled mobile robots run fast on rough terrain, due to the robot body acceleration and oscillation, sensors mounted on the robot body may be destroyed. In this pa¬per, we propose a scheme to reduce the body acceleration at any specified location on the robot body. In the proposed scheme, a combined ideal model is designed so that the location where acceleration performance becomes best can be moved easily by setting only two design parameters. Then, an adaptive controller is developed so that the behavior of the actual mobile robot tracks that of the combined ideal model. It is ascertained by numerical simulations that the body acceleration at any specified location can be improved easily.

Fig. 2 Mobile robot model

Room C

OS4 Bio-inspired theory and applications I

Chair: Ikuo Yoshihara (University of Miyazaki, Japan)
Co-Chair: Moritoshi Yasunaga (University of Tsukuba, Japan)

OS4-1 Solving Sudoku with Bayesian optimization algorithm

Shinichi Shirakami and Yuji Sato
(Hosei Univercity, Japan)

Recently, the Estimation of distribution algorithm (EDA) has been studied as a measure to solve the problem that the Genetic algorithm (GA) destroys effective building blocks. The Bayesian optimization algorithm (BOA) that is one of EDAs evolves a population of candidate solutions by building and sampling Bayesian networks. However, the BOA has some problems, for example the processing time is too longer. In this paper, we use the Sudoku puzzle that is one of the real problems, focusing on the problem of processing time and convergence to local solution. We propose the method defined chromosome combined nine candidate regions would make it possible to compress the search spaces. We evaluate this method by using two types of Sudoku puzzles and comparing result of the method that defines a one-dimensional chromosome that has a total length of at most 324 binary numbers and converts binary numbers into integer numbers to the result of our proposal method. In the result, our proposal method reduces processing time and amount of generations than the original program and performs as precision as the original program.

OS4-2 Parallelization of genetic operations that takes building-block linkage into account

Hazuki Inoue[1], Naohiro Hasegawa[1], Mikiko Sato[2], and Yuji Sato[1]
([1]Hosei University, Japan)
([2]Tokyo University of Agriculture and Technology, Japan)

Previously, we proposed genetic operations that consider effective building blocks for using genetic algorithms (GA) to solve Sudoku puzzles, and proposed also a stronger local search function. In this paper, we propose performance enhancement by parallelization of genetic operations takes building-block linkage into account. In other words, parallelize sub-blocks (regions) of Sudoku puzzles. Valid parallelization of genetic operations becomes a strong method of speed-up in conjunction with parallelization of individuals, since parallelization of genetic operations is not competing with parallelization of individuals. We show using multi-core processors and OpenMp that parallelization of genetic operations have positive effect of for speeding up.

January 21 (Saturday), 08:40–10:10

OS4-3 A detection method for intronic snoRNA genes using extended-weight-updating SOM with appearance probability of bases

Takuro Matsuo, Junichi Iwakiri, Kunihito Yamamori, Naoya Kenmochi, and Ikuo Yoshihara
(University of Miyazaki, Japan)

Small nucleolar RNAs (snoRNAs) are known that they will participate with RNA modification. However, details of snoRNA's functions have not been clear still yet. In order to make clear functions of snoRNA, finding snoRNAs and studying their works in cells are required. In this paper, we propose a method to detect snoRNA genesusing extended-weights-updating Self-organizing Map (eSOM). An input vector to eSOM consists of a feature vector and a target vector. A winner node for an input vector is decided by the feature vector, and all the weights around the winner node are updated to be close to the input vector. We employ base appearance probability and the complementary base pair ratio for feature vector only, and a flag for target vector. Experimental results showed our method achieved 91% and 93% detection ratio for boxC/D and boxH/ACA type snoRNA gene, respectively.

OS4-4 A method to detect intronic snoRNA genes using characteristic base patterns of DNA sequences

Chen Xue, Junichi Iwakiri, Kunihito Yamamori, Naoya Kenmochi, and Ikuo Yoshihara
(University of Miyazaki, Japan)

In recent researches of molecular cell biology and bioinformatics, it is one of the most important tasks to find and analyze functional RNAs, called as non-coding RNAs (ncRNAs) those do not carry any information to synthesize protein, but participate in post-translational modification. In this paper, we propose a method to detect intronic genes of small nucleolar RNA (snoRNA), it is a kind of functional RNA. The snoRNAs exist in the nucleolus, and contribute to the ribosomal RNA (rRNA) modification process. From their structure, snoRNAs can be classified into two types; the Box C/D type and the Box H/ACA type. Since each of them has some characteristic base sequences. We aim to detect snoRNA genes based on these characteristic base sequences and secondary structures. We evaluate proposed method by comparative experiments with other kernel function methods.

Room D

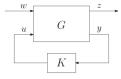## OS12 Control Theory and its Application

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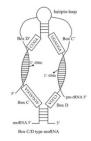Co-Chair: Nobuya Takahashi (University of Miyazaki, Japan)

OS12-1 Propose of the use to alternative Gramian for the controller order reduction
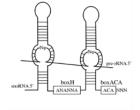
Shota Usui[1], Tsutomu Nagado[2], and Michio Kono[3]
([1]Miyakonojo National College of Technology, Japan)
([2]University of the Ryukyus, Japan)
([3]University of Miyazaki, Japan)

Robust controllers have feature of corresponding to the model error and the disturbance. However, obtained controller is generally high-order. The controller order is desirable in small from a standpoint of cost and reliability. The purpose of our work is to propose of effective controller order reduction method. In this paper, we propose a controller order reduction method using alternative Gramian. We were applied this method to conventional methods. Further, we confirmed effect using the numerical example. As a result, our proposed method found some efficacy in stability and performance degradation of a closed loop system. However, when applied to other controlled objects, these was relatively-ineffective. Therefore, this method admit of improvement. As one of these improvements, we are thinking that to use Genetic Algorithm (GA) for optimal solution derivation of the riccati inequality.
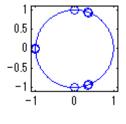
January 21 (Saturday), 08:40–10:10

OS12-2 Classes of linear systems of difference equations with bounded solutions

Naoharu Ito[1], Reinhold Küstner[2], and Harald K. Wimmer[3]
([1]Nara University of Education, Japan)
([2] Universität Hannover, Germany)
([3] Universität Würzburg, Germany)

In this paper we investigate higher order systems of linear difference equations where the associated characteristic matrix polynomial is self-inversive. We consider classes of equations with bounded solutions. It is known that stability properties of higher order systems of linear difference equations are determined by the characteristic values of the corresponding matrix polynomials. All solutions are bounded (in both time directions) if the spectrum of the corresponding matrix polynomial lies on the unit circle, and moreover if the characteristic values of modulus one are semisimple. If the corresponding matrix polynomial is self-inversive then one can use the inner radius of the numerical range to obtain a criterion for boundedness of solutions. We show that all solutions are bounded if the inner radius is greater than 1. In the case of matrix polynomials with positve definite coefficient matrices we derive a computable lower bound for the inner radius.

OS12-3 Dynamic window-based obstacle avoidance in the presence of moving obstacles

Hitomi Harada, Masahiro Yokomichi, and Osamu Sato
(University of Miyazaki, Japan)

This paper proposes a reactive control method for mobile robots in the presence of moving obstacles. The method is based on the dynamic window algorithm and extends it in order to avoid moving obstacles efficiently. Firstly, the future collision is detected based on the generalized velocity obstacles. Secondly, input value can be varied within the prediction horizon. This means that better input can be selected such that the robot starts passing maneuver ealier. However, this causes the dimension of the search space larger. In order to reduce the computation time, GDS (gradually dense-sparse) discretization and randomized sampling method similar to RRT is adopted. By means of these extensions, the robot can avoid moving obstacles with simpler cost function and reasonable computation time. Performance of the proposed method is evaluated by numerical simulations.

OS12-4 Multimodal MSEPF for visual tracking

Masahiro Yokomichi and Yuki Nakagama
(University of Miyazaki, Japan)

Recently, particle filter has been applied to many visual tracking problems and it has been modified in order to reduce the computation time or memory usage. The one of them is the Mean-Shift embedded particle filter (MSEPF, for short) and Randomized MSEPF. These methods can decrease the number of the particles without the loss of tracking accuracy. However, the accuracy may depend on the definition of the likelihood function (observation model) and of the prediction model. In this paper, the authors propose an extension of these models in order to increase the tracking accuracy. Furthermore, the expansion resetting method, which was proposed for mobile robot localization, and the changing the size of the window in Mean-Shift search are also selectively applied in order to treat the occlusion or rapid change of the movement.

January 21 (Saturday), 08:40–10:10

Room E

OS25 Network Dynamics in Biological Information Systems I

Chair: Hideyuki Suzuki (The University of Tokyo, Japan)
Co-Chair: Takashi Kohno (The University of Tokyo, Japan)

OS25-1 Analytical approach to synchrony between populations of neurons with modulatory effects

Yoichiro Hashizume and Osamu Araki
(Tokyo University of Science, Japan)

We have analyzed the synchrony of neurons using the effective input theory. First, the dependence of intra-regional synchrony on the strength of synaptic connections is clarified. When the synaptic connections are weaker than thresholds of neurons, spontaneous firings do not exist. Second, we have studied the inter-regional synchrony of two regions connected by modulatory common noises. As a result, under the appropriate modulatory-effects there exist nontrivial sets of synchronized states of regions. Furthermore, at least one of these two regions satisfies the condition of intra-regional synchrony. When both regions do not satisfy the condition of intra-regional synchrony, these two regions should have the same structure of synaptic connections in order to synchronize inter-regionally.

OS25-2 A computational model for multiple potential actions for inferred movement goals

Takuro Fujimura, Yuta Kakimoto, and Osamu Araki
(Tokyo University of Science, Japan)

Klaes et al. showed that multiple potential actions could be generated only single spatial cue according to task rule. Also they reported that population activities of the PPC neurons which represent two different motor goals might be biased. The motivation of this paper is to make a computational model which can reproduce Klaes's experimental results. We have proposed a decision making model which has the PFC layers encoding the rule informations and showed that the potential action for the inferred goal was observed in the PPC layer, and the balance of the potential actions in the PPC layer varied depending on the connection strength from PFC to PMd. These results suggest that the observed biased potential actions during the memory periods were the result of "trade-off" for achieving the balanced multiple potential actions while the spatial cue was presented.
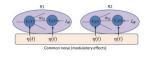
OS25-3 An action planning model using short-term and long-term memory information during learning of sequential procedures

Nao Tomoda, Yuta Kakimoto, and Osamu Araki
(Tokyo University of Science, Japan)

To make an action plan, it is thought that the brain uses memory systems. Thus, we propose an action plan model, which deals with the physiological experiments to push buttons in the correct order. In the model, there are two independent action-planning systems of long-term memory and working memory. When the stimulus set is input, they propose action plans, and the selection is decided in a competitive way via the value of estimation parameters. As a result, the model reproduces similar behaviors to the biological data. Especially our model make errors at first but it gradually learns correct responses by trial and error utilizing the memory systems as the monkey did in the physiological experiment. The results suggest that SMA and pre-SMA may have close relationships to the entries to long-term memory and working memory systems in the brain.

January 21 (Saturday), 08:40–10:10

OS25-4   Coherence patterns in neural fields at criticality

Teerasit Termsaithong, Makito Oku, and Kazuyuki Aihara
(The University of Tokyo, Japan)

Phase synchronization is a mechanism that plays a crucial role for information processing in the brain, and coherence is one of methods that are used to evaluate pairwise degree of phase synchronization. Coherence is also an important measure for examining brain functions because it can indicate communication and cooperation among neurons. In this work, we study the coherence patterns of spontaneous activity in the neural field model at criticality, which is a region where a second order phase transition occurs. The results are summarized as follows. First, at high frequency bands, the system outside the critical regime cannot communicate via phase synchronization at all. Second, the dynamical coherence patterns in the critical regime show switching between high and low coherent states. Finally, we found that in a very brief period of time, there is the high broadband coherence between some pairs of spatial points. This phenomenon can be observed only in the critical regime.

Room F

OS27 System sensing and control

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

OS27-1   The evaluation of the emotion by NIRS

Hirotoshi Asano, Takanori Sagami, and Hideto Ide
(Aoyama Gakuin University, Japan)

We experimented for the purpose of development of the objective evaluation technology of emotions. Persons requiring care will also increase in number with the increase in this population. In the case of the person requiring care who lost the function to convey an intention especially, the objective judgment to a physical and mental pain is required. Specifically, we gave subjects stimulus of a comfortable or an uncomfortable sound and measured concentration of the oxygenated hemoglobin of a frontal lobe part by Near-Infared Spectroscopy. Based on the experimental result, a comfortable state or an uncomfortable state was distinguished concentration of the oxygenated hemoglobin using the bayesian network. As a result, we were able to estimate the subject's psychological condition.

OS27-2   A reward allocation method for reinforcement learning in stabilizing control tasks

Shu Hosokawa, Joji Kato, and Kazushi Nakano
(The University of Electro-Communications, Japan)

Reinforcement learning is a machine learning method that does not require a detailed teaching signal by a human, which is expected to be applied to real robots. In its application to real robots, the learning processes are required to be finished in a short learning period of time. A reinforcement learning method of non-bootstrap type has fast convergence speeds in the tasks such as Sutton's maze problem that aim to reach the target state in a minimum time. However, these methods are difficult to learn either task to keep a stable state as long as possible. In this study, we improve the reward allocation method for stabilizing control tasks. The validity of our method is demonstrated through simulation for stabilizing control of an inverted pendulum. Our proposed method can acquire a policy in order to keep a stable state within a short learning period of time.

January 21 (Saturday), 08:40–10:10

OS27-3 Acquisition of stationary behavior based on Multiagent Enforced SubPopulations

Joji Kato, Shu Hosokawa, and Kazushi Nakano
(The University of Electro-Communications, Japan)

This paper presents a solution for the problems of state representation as well as a variety of optimal solutions in multiagent systems. These problems cannot be solved by traditional reinforcement learning methods such as Sarsa(λ). We apply a method of Multiagent Enforced SubPopulations to the task of stationary behavior acquisition. The stationary behavior acquisition task means that the agents continue to select behavior in order to keep the stationary state. The behaviors of acquired agents are not uniquely determined in those tasks. In addition, there is a state representation problem in multiagent systems due to the complexity of the system. Furthermore, there is no example of the Multiagent Enforced SubPopulations applied to these types of tasks, in which the design policy of the fitness function is unclear. We demonstrate the validity of our proposed method
through comparison with a Keepaway task in RoboCup Soccer as a stationary behavior acquisition task.

OS27-4 Robust digital control of DC-DC buck converter with various frequency samplings

Yuji Fukaishi[1], Yoshihiro Ohta[1], Kohji Higuchi[1], Eiji Takegami[2],
Satoshi Tomioka[2], and Kosin Chamnongthai[3]
([1]The University of Electro-Communications, Japan)
([2]TDK-LAMBDA K.K., Japan)
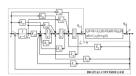([3]King Mongkut's University of Technology Thonburi, Thailand)

Robust DC-DC converter which can covers extensive load change and also input voltage changes with one controller is needed. Then demand to suppress output voltage change becomes still severer, We propose an approximate 2 DOF digital controller which realized the startup response and dynamic load response independently. Controller make the control bandwidth wider, and at the same time make variations of the output voltage small at sudden changes of load and input voltage. In this paper a new approximate 2DOF digital control system with additional zeros is proposed. Using additional zeros second-order differential transfer characteristics between equivalent disturbances and output voltage are realized. Therefore the new controller makes variations of the output voltage smaller and sudden changes of load and input voltage. These controller is actually implement on a DSP and is connected to DC-DC converter.
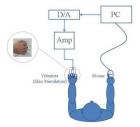Experimental results demonstrate that this type of digital controller can satisfy given severe specifications with low frequensy sampling.

OS27-5 EMG analysis accompanied by tactile apparent movement

Ali Mokhtari and Masafumi Uchida
(The University of Electro-Communications, Japan)

Tactile apparent movement recognition is normally considered as a subjective sense of human. Applying the tactile apparent movement to an engineering system, a quantitative evaluation study becomes necessary. In previous studies, finding the body-sway caused by the tactile apparent movement in a fixed experimental condition became possible. However, characteristic of the body-sway was not thoroughly investigated. In this study, investigating the body-sway caused by tactile apparent movement in a fixed experimental condition was aimed. Therefore, we focused on biological information, the body-sway and the comparison between the apparent movement recognized trials and the non-recognized trials. The findings of this research will be conducive to optimize the performance of the systems that are using the tactile apparent movement.

Room A

OS2 Aware Technologies for e-Services

Chair: Kiyota Hashimoto (Osaka Prefecture University, Japan)
Co-Chair: Sachio Hirokawa (Kyushu University, Japan)

OS2-1   Visual chance discovery method of potential keys for innovations in tourism

Kiyota Hashimoto[1], Kazuhiro Takeuchi[2], Makoto Okada[1], and Sachio Hirokawa[3]
([1]Osaka Prefecture University, Japan)
([2]Osaka Electro-Communication University, Japan)
([3]Kyushu University, Japan)

Online customer reviews have been variously employed for text mining and information retrieval in general. However, the result of those analyses has to be well visualized for prospective innovations of firms and enterprises that cannot afford a dedicated expert. In this study, we collected thousands of online customer reviews of hotels and restaurants, and divided them into a couple of groups according to customers' conditions to use those hotels and restaurants. We then made keygraphs of common keywords for each group and compared them visually. This method enables service providers with little knowledge of text mining to grasp different preferences of customers, and thus to improve their services in a more personified way.

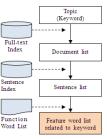### OS2-2   An improved method to extract landmarks information for the purpose of using maps and route

Shunichiro Sugimori, Yuki Murai, Makoto Okada, and Kiyota Hashimoto
(Osaka Prefecture University, Japan)

When we want to go somewhere, we usually prepare maps, route and route descriptions. In that situation, we need these data to understand easy the map data and route descriptions, to contain appropriate information to reach to destinations from starting points, such as landmarks information and action points, and not to contain ambiguous information. In this paper, we investigate difference between human route descriptions and those made automatically by Google Maps API in order to obtain the guidelines for good route descriptions.

OS2-3   Automatic generation of tourism quiz using blogs

Jun Zeng, Toshihiko Sakai, Chengjiu Yin, Takahiko Suzuki, and Sachio Hirokawa
(Kyushu University, Japan)

The one-way information provision can not impress the listeners well. As an efficient way, Question & Answer can help information provider understand the response of listeners. However, it is not easy for everyone to set a suitable question. In this paper, we propose an automatic quiz generation system using tourism blogs. The system can generate the quiz by extracting feature words of the topic keyword from the blogs. Our purpose is to help the tourism information providers to advertise their tourism events in an interactive way, in order to impress the tourists. By comparing with other method of quiz generation, we demonstrate that our method is more suitable for information provision.

January 21 (Saturday), 10:30–12:00

OS2-4   Sharing knowlede and experience of search with SNS

Xiaobin Wu, Jun Zeng, Chengjiu Yin, and Sachio Hirokawa
(Kyushu University, Japan)

The investigation activities using a search engine are indispensable to acquisition of new knowledge. When we investigate using a search engine, we leave a memo if needed, seeing the search results to an input keyword. Depending on the case, search refinement and search by a new related keyword are repeated. However, it is difficult to share the knowledge and the experience acquired under investigation activities with the others. On the other hand, SNS which promotes relation with people and a person attracts attention. This paper proposes a community type search platform which combines a search engine and SNS. By seamless use of various activities in search and the mutual comments, users can share a problem or new knowledge.

OS2-5   A method of sentiment analysis for online reviews containing values of multi-criteria evaluation

Takaya Nishikawa, Makoto Okada, and Kiyota Hashimoto
(Osaka Prefecture University, Japan)

Online reviews of commercial sites are important sources for customers to obtain information and opinions. However, generally, these reviews contains several mixed information such as purpose and sentiments of reviewers. Therefore users need the method to separate these data and extract appropriate information from the reviews. In this paper, we investigated effectiveness of a method of machine learning Support Vector Machine (SVM) whether the method can classify reviews appropriately or not by using reviews of a travel information web site "TripAdvisor". We also investigate difference of precisions according to source textual data such as morpheme, bigram and trigram.

Room B

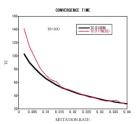## OS5 Bio-inspired theory and applications II

Chair: Kunihito Yamamori (University of Miyazaki, Japan)
Co-Chair: Yuji Sato (Hosei University, Japan)

OS5-1   Stochastic analysis of OneMax problem by using Markov chain

QingLian Ma[1], Yu-an Zhang[2], Kiminobu Koga[1], and Kunihito Yamamori[1],
Makoto Sakamoto[1], and Hiroshi Furutani[1]
([1]University of Miyazaki, Japan)
([2]Qinghai University, P. R. China)

An experimental and analytical investigations are performed for OneMax problem using Wright-Fisher model. This study investigates the distribution of the first order schema frequency in the evolution process of Genetic Algorithm (GA). Effects of mutation in GA is analyzed for the standard mutation and asymmetric mutation models. If a population is in linkage equilibrium, it can be shown that OneMax problem is equivalent to the asymmetric mutation model. Thus we can apply theoretical results obtained in the asymmetric mutation model to OneMax problem, and investigate the convergence time within the framework of Wright-Fisher model.

January 21 (Saturday), 10:30–12:00

OS5-2   High signal and power integrity design for VLSI packaging using genetic algorithms

Moritoshi Yasunaga[1], Hiroki Shimada[1], Shohei Akita[1], and Ikuo Yoshihara[2]
([1]University of Tsukuba, Japan)
([2]Miyazaki University, Japan)

Waveform distortion is one of serious problems in electronic packaging design in GHz-era because conventional impedance matching techniques for waveform improvement do not work anymore. In order to overcome this difficulty and to ensure the signal and power integrities (SI and PI), we have proposed a new techniques called segmental transmission line (STL) already. The STL does not adopt the impedance matching but impedance mismatching between the adjacent segments. We have applied the STL to some transmission systems and have showed its effectiveness in prototype measurements. In this paper, we apply the STL to another transmission system and show it effectiveness. Furthermore, we demonstrate the STL's high waveform learning capability changing the input signal.

OS5-3   Solving a multi-objective constraint satisfaction problem with genetic algorithms -Making a food menu with GAs-

Hironori Fukamachi and Yuji Sato
(Hosei University, Japan)

Generally, it is difficult to make a food menu composed from many limitations. In this paper, we define the problem to make a menu of the one-week meal as a multi-objective constraint satisfaction problem with the upper and the lower limitations. We considered the nutritional composition and a composition of meals. Thereby, the composition of a menu which structured at one composition ought to compete with the nutritional composition. Additionally, we propose a method to apply Genetic Algorithm solving this making menu problem, thus we evaluate menus by applying multiple functions with GA. In conclusion, the results means that the composition of meals don't compete with the nutritive composition, moreover these are not correlation.

OS5-4   Improvement of the reinforcement learning efficiency using individually reward value allotment of the soccer video game agent
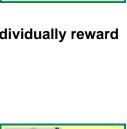
Daisuke Inami, Yuuki Sakaguchi, and Yuji Sato
(Hosei University, Japan)

Recently, soccer game algorithm has become shorter life cycle, due to complex game environment. We proposed hybrid classifier system for soccer video game simulation in recent paper and it indicated that hybrid classifier system is effective for online soccer strategy learning system. In this paper, we propose an individually role assignment for soccer game agent to reduce learning time and to achieve higher winning rate. We investigated individually role assignment by referring using real world soccer role assignment. Forwards agent's reward of shot should be high, and midfielder agent's should be separated into center and outer. We evaluated learning efficiency of our algorithm. As a result, it was found that winning rate of our algorithm with individually role assignment achieved greater than our former algorithm without individually role assignment.

January 21 (Saturday), 10:30–12:00

Room C

OS8 Computer Vision and Sound Analysis

Chair: Yasunari Yoshitomi (Kyoto Prefectural University, Japan)
Co-Chair: Masayoshi Tabuse (Kyoto Prefectural University, Japan)

OS8-1   Pedestrian detection and tracking in near infrared images

Masayoshi Tabuse[1] and Sayuri Kozawa[2]
([1]Kyoto Prefectural University, Japan)
([2]Sumitomo Forestry Archi Techno Co., Ltd., Japan)

We present a method for pedestrian detection applied to near infrared images. Near infrared ray is invisible, so that near infrared images are useful for surveillance systems day and night under near infrared light. In our method we use histograms of oriented gradient features and support vector machine. Furthermore, we present pedestrian trajectories using mean shift and nearest neighbor methods.

OS8-2   A system for facial expression recognition of a speaker using front-view face judgment, vowel judgment and thermal image processing

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

For facial expression recognition, we previously selected three images: (i) just before speaking, and speaking (ii) the first vowel and (iii) the last vowel in an utterance. A frame of the front-view face in a dynamic image was selected by estimating the face direction. Based on our method, we have been developing an on-line system for recognizing the facial expression of a speaker using front-view face judgment, vowel judgment and thermal image processing. In the proposed system, we used three personal computers connected by cables to form a local area network. As an initial investigation, we adopted the utterance of the Japanese name "Taro," which is semantically neutral. Using the proposed system, the facial expressions of one male subject were discriminable with 76% accuracy when he exhibited one of the intentional facial expressions of "angry," "happy," "neutral," "sad," and "surprised."

OS8-3   Robust facial expression recognition of a speaker using thermal image processing and updating of fundamental training-data

Yuu Nakanishi, Yasunari Yoshitomi, Taro Asada, and Masayoshi Tabuse
(Kyoto Prefectural University, Japan)

We previously developed a method for the facial expression recognition of a speaker. For facial expression recognition, we selected three static images: (i) just before speaking and speaking (ii) the first vowel and (iii) the last vowel in an utterance. Then, only the static image of the front-view face was used for facial expression recognition. However, frequent updates of the training data were time-consuming. To reduce the time for updates, we found that the classifications of "neutral," "happy," and "others" were efficient and accurate for facial expression recognition. Using the proposed method with updated training data of "happy" and "neutral" after an interval such as approximately three and a half years, the facial expressions of two subjects were discriminable with 87.0% accuracy for the facial expressions of "happy," "neutral," and "others" when exhibiting the intentional facial expressions of "angry," "happy," "neutral," "sad," and "surprised."

Table 1. Recognition accuracy of Case-A-1-2
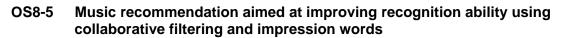(a) Training data: First_period_A,
   Test data: Second_period_A

		Input facial expression		
		Happy	Neutral	Others
Output	Happy	100	10	86.7
	Neutral		90	
	Others			13

(b) Training data:
   "happy" and "neutral"; Second_period_A,
   "others"; First_period_A,
   Test data: Second_period_A

		Input facial expression		
		Happy	Neutral	Others
Output	Happy	100		6.7
	Neutral		90	
	Others		10	93.3

January 21 (Saturday), 10:30–12:00

OS8-4   A system for synchronizing nods of a computer-generated character and a speaker using thermal image processing

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

The purpose of our study was to develop a system for communication between a speaker and a computer-generated (CG) character for making the speaker feel more peaceful and cheerful. In our system, the CG character can synchronize its nodding with a speaker's nodding by predicting the speaker's nodding angle. The CG character starts predicting it for nodding just after a human begins to speak, and the CG character stops nodding while maintaining a front-view face when the human maintains a front-view face and is silent. The CG character starts predicting it again for nodding when the human begins to speak again. The measured feature parameter is the input to a fuzzy algorithm system to obtain the nodding angle of the speaker in front of an infrared ray camera, and then a moving-average model is used to predict the nodding angle of the speaker.

OS8-5   Music recommendation aimed at improving recognition ability using collaborative filtering and impression words

Chikoto Koro[1], Yasunari Yoshitomi[2], Taro Asada[2], and Saya Yoshizaki[2]
([1]ISI Software Corp., Japan)
([2]Kyoto Prefectural University, Japan)

Music therapy to improve recognition ability may be more effective when the favorite music of each person is adopted. A method is proposed that combines collaborative filtering and music recommendation based on impression words. In the proposed method, once the recommendation process using collaborative filtering is terminated because the number of users is zero in the reference user list of users with the same preference of recommended music, the second recommendation process finds the most similar music from the scores of impression words, so that music is successfully recommended from music not previously recommended. In experiments, 12 users rated 52 songs in a textbook database of songs for elementary schools. The number of recommended songs by the proposed method was 10 per user, whereas that of collaborative filtering was 6.25 per user. The recommendation accuracy of the proposed method was 68.3%, whereas that of collaborative filtering was 66.9%.

Room D

OS14 Embracing Complexity in System Sensing

Chair: Yoshiteru Ishida (Toyohashi University of Technology, Japan)
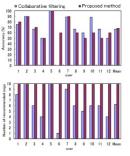Co-Chair: Yuji Watanabe (Nagoya City University, Japan)

OS14-1   A multipath immunity-based statistical en-route filtering in wireless sensor networks

Yuji Watanabe and Tomotsugu Tamura
(Nagoya City University, Japan)

In our previous studies, we have proposed an immunity-based statistical en-route filtering (ImSEF) to not only eliminate false data injection attack in wireless sensor networks but also identify compromised nodes which are injecting false data. Some simulation results showed that ImSEF outperformed the original SEF. However, ImSEF does not deal with false negative attack where a compromised node can block legitimate reports from forwarding through it. In addition, ImSEF mistakenly filter out legitimate reports en-route with low probability (mistaken filter). In this paper, we propose a multipath immunity-based statistical en-route filtering (ImMEF) to combat both the false negative attack and the mistaken filter. Like a multipath en-route filtering method (MEF) proposed by Kim and Cho, ImMEF exploits a multipath routing technique and a random key pre-distribution scheme for key assignment. We carry out some simulations to evaluate the performance of ImMEF.

January 21 (Saturday), 10:30–12:00

OS14-2   Extraction of operational behavior for user identification on smart phone

Yuji Watanabe and Shunta Ichikawa
(Nagoya City University, Japan)

A smart phone has a large amount of private information, so that user authentication and identification are important to prevent attacks by illegal users who are not the owner of the smart phone. Both password authentication and biometrics can be applied only at the beginning of use. After the authentication is passed, not only the legal owner but also illegal users freely use the phone. For the second protection, the behavior-based user identification can continuously check the user activities after login. In this paper, we investigate operational behaviors at the first stage for user identification on smart phone. We make a text browsing application to record fingers history on smart phone. From the recorded fingers history, we extract and compare characteristic operational behaviors, for instance, the speed and the acceleration of fingers, the distance between fingers, and the distribution of touched region.

OS14-3   Continuous review model of mutual support supply system for disaster response

Nur Budi Mulyono and Yoshiteru Ishida
(Toyohashi University of Technology, Japan)

Mutual support of supply is needed to leverage number of stock between shelters during disaster response time. The goal of this research is to develop reactive lateral stock transshipment between shelters based on traditional continuous review inventory model in which demand and delivery lead time information are greatly biased. This paper presents self-repair framework that provide an emergency relief strategy after natural disaster events. In addition, supply system buffer analysis also presented to enrich model development. A case study focused on volcanic eruption disaster at Merapi Mountain Indonesia, illustrate application of the model.
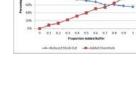
OS14-4   Network rewiring by matching automaton: from unit reliability to collective survivability

Yoshiteru Ishida and Masahiro Tokumitsu
(Toyohashi University of Technology, Japan)

Collective intelligence of a group of intelligent robots can be realized as autonomous distributed robots with an advent of sensor network. Collective survivability can also be regarded as a subject of group problem solving, and realized by a framework of network rewiring (dynamic configuration) of systems. To realize the network rewiring, separation of physical systems and information systems is proposed to apply the self-rewiring network as well as self-repairing and self-recognition networks. Self-rewiring algorithm can be formalized as a matching automaton. An application to autonomous distributed satellites will be discussed.

January 21 (Saturday), 10:30–12:00

Room E

OS23 Mechatronics and Intelligent Systems

Chair: Maki K. Habib (American University in Cairo, Egypt)
Co-Chair: Ju-Jang Lee (KAIST, Korea)

OS23-1   Modified local Gaussian Process Regression for inverse dynamics learning

Seung-Yoon Cho, Sung-Soon Yim, and Ju-Jang Lee
(KAIST, Korea)

The robot played more and more important role on our life. The precise control of robot can be more and more important. In the robot manipulator control problem, the robot inverse dynamics is important because it can allow accurate robot control such as computed torque control. If the robot inverse dynamics is accurate, one can accurate, effective control. The computed torque control can allow low-gain control and nonlinear control. A robot inverse dynamics is significant; however, modeling the rigid-body model of inverse dynamic is not simple and accurate because of nonlinearity. As the degree of freedom is increased, modeling of inverse dynamics is more difficult. Robots have been playing an important roles on our life. In various field such as entertainment, military, space and medical fields, the precise control is required according to the increase of the importance on robot. In robot manipulator position control problem, modeling robot inverse dynamics is important because it can allow accurate robot control using computed torque control and PD control with computed feedback . ...

OS23-2   Bioinspiration and modern actuators

Maki K Habib[1], Keigo Watanabe[2], and Fusaomi Nagata[3]
([1]American University in Cairo, Egypt)
([2]Okayama University, Japan)
([3]Tokyo University of Science, Japan)

Biological systems in nature went through long evolution process that led to highly effective and efficient systems with excellent performance. Biomimetics is an interdisciplinary scientific research focuses on making nature as new sources of inspiration to study, analyze and design of creative and efficient engineering systems supported by innovative technologies. Smart materials are the foundation supporting the development of creative bioinpiration. Wide ranges of biologically inspired systems have been developed. However, engineering such biomimetic intelligent creatures were hampered by physical and technological constraints, and it is still a challenge. Actuators are essential elements within Mechatronical systems due to their important role in motion control systems and hence the development of modern actuators can be inspired from biological actuation systems in nature associated with different level of control. Making intelligent creatures that are actuated by biologically inspired modern actuators and artificial muscles would create new reality with great potentials. This paper provides the concept of Biomimetic as an interdisciplinary field, discusses the enabling technologies, and presents the development of biologically inspired actuators.

January 21 (Saturday), 10:30–12:00

OS23-3   Ubiquitous system and its apapplication networks

Young Im Cho
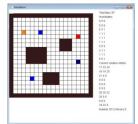(The University of Suwon, Korea)

Many ubiquitous systems and technologies have been developed as of now. As known the goal of ubiquitous computing is to achieve the well-being life. There are four different aspects for achieving ubiquitous computing, namely, they are within the computing paradigm, technical principle, application domain and application space. Nowadays, ubiquitous city (U-City) is the most applicable domain in the world. Therefore, the talk will mainly introduce and discuss an overview of the U-City idea and the known ubiquitous computing systems as well as new trends in this field.

OS23-4   Simultaneous optimization of path planning and flow shop scheduling by bacterial memetic algorithm

János Botzheim[1], Yuichiro Toda[2], and Naoyuki Kubota[2]
([1]Széchenyi István University, Hungary)
([2]Tokyo Metropolitan University, Japan)

The paper deals with simultaneous optimization of path planning of mobile robots and flow shop scheduling problem. The goal of the path planning problem is to determine an optimal collision-free path between a start and a target point for a mobile robot in an environment surrounded by obstacles. The objective is to minimize the path length without colliding with an obstacle. On the other hand, shop scheduling problems deal with processing a given set of jobs on a given number of machines. Each operation has an associated machine on which it has to be processed for a given length of time. The problem is to minimize the makespan, i.e., the overall time demand of the whole process. In this paper we deal with two robots carrying items between the machines. Bacterial memetic algorithm is proposed for solving the problem.

OS23-5   Lateral controller design for an unmanned vehicle via Kalman filtering

Man Hyung Lee[1], Hyung Gyu Park[1], Kil Soo Lee[1], Young Chul Cha[1], Dong Jin Kim[1], Byung Il Kim[2],
Sinpyo Hong[1], Ho Hwan Chun[1], Bong Jin Lee[1], and Yun Ja Lee[1]
([1]Pusan National University, Korea)
([2]Hyundai Motor Company, Korea)

This paper proposes a lateral control system for an unmanned vehicle to improve the responsiveness of the system with a PD control. Heading error can be stabilized and the transient response characteristics can be improved with the controller. In this paper, a mathematical modeling of the vehicle dynamics using two degrees of freedom is used for the controller design. Waypoint tracking method of autonomous navigation was done with the Point to Point algorithm with position and heading measurements from GPS receivers via Kalman filtering. Performance of the designed controller was verified through experiment with a real vehicle.

OS23-6　Unmanned container transporter via pseudolite ultrasonic system

Man Hyung Lee[1], Kil Soo Lee[1], Young Chul Cha[1], Dong Jin Kim[1], Jung Hyun Moon[2],
Fumio Harashima[3], Bong Jin Lee[4], Sung Mi Kim[4], and Yun Ja Lee[4]
([1]Pusan National University, Korea)
([2]Aztechs Co., Ltd, Korea)
([3]Tokyo Metropolitan University, Japan)
([4]Pusan National University, Korea)

This paper presents studies on the Kalman filtering of yaw angle and vehicle position in the integration of an inertial measurement unit(IMU) with a new accurate real-time ultrasonic distance measurement system on a unmanned container transporter(UCT). Experimental tests conducted with a very low grade IMU and pseudolite ultrasonic system(PUS) measurement system showed that a moving vehicle's position can be estimated with a few centimeters accuracy. The test results confirmed that angular motions and vehicle positions improve the estimates of yaw angle and angular velocity, respectively.

Room F

OS26 Network Dynamics in Biological Information System II

Chair: Hideyuki Suzuki (The University of Tokyo, Japan)
Co-Chair: Takashi Kohno (The University of Tokyo, Japan)
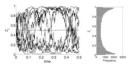
OS26-1　A network consisting of phase adjusting units

Masanori Shiro[1,2], Syotaro Akaho[1], Japan, and Kazuyuki Aihara[2]
([1]AIST Human Technology Research Institute, Japan)
([2]University of Tokyo, Japan)

We propose a one-step prediction method by using a simple network consisting phase adjusting units. The network is for learning a continuous time series. Each unit have a function of amplitude and phase adjusting. We tried to predict a point for nonlinear time series like as a logistic map by using the lasso algorism.

OS26-2　Modeling of potential- and noise-induced intracellular dynamics with cell-cell communication

Tomoyuki Yamada[1], Atsushi Kamimura[1], and Tetsuya J. Kobayashi[1,2]
([1]The University of Tokyo, Japan)
([2]Japan Science and Technology Agency, Japan)

In cellular systems, complicated intracellular reaction circuits implement various types of information processing in response to external stimuli such as decision-making. These processes involve stochastic fluctuations owing to low copy numbers of molecules per cell and uncertainty of environmental signals. Major mechanisms that can cope with such noise, known currently, are potential-induced bistability at the single-cell level, or mutual communication at the population level. Another mechanism, noise-induced bistability, is recently demonstrated to be connected to optimal noise-filtering dynamics from external stimuli. In this work, we focus on the difference of potential-induced and noise-induced dynamics in terms of their information processing ability. Furthermore, we investigate the effect of mutual communication to the noise-induced dynamics. To address these problems, we propose a mathematical model of an intracellular network that combines both bistablility. In addition, we also investigate the impact of intercellular communication.

January 21 (Saturday), 10:30–12:00

OS26-3 Cholinergic top-down modulation based on the free-energy principle

Masaaki Takada and Kazuyuki Aihara
(The University of Tokyo, Japan)

Acetylcholine (ACh) has a key role in the cortex in perception. Although cholinergic modulations have been revealed in recent experimental studies, it remains unclear what is the essential role of ACh. In order to clarify the crucial computational function of ACh in perceptual inference, we propose a model of cholinergic top-down modulation based on the free-energy principle in this paper. We made the only assumption that ACh modulates the magnitude of top-down processing. Then, dynamics of the ACh level is derived by the free-energy principle. Our model suggests that ACh reports uncertainty of top-down information and reduces noise of top-down input. Thus, ACh can contribute to precise perception.

OS26-4 Dynamics of associative memory network with self-oscillatory and non-self-oscillatory oscillators

Yusuke Okada, Yuichi Katori, Kazuyuki Aihara, Hideyuki Suzuki
(The University of Tokyo, Japan)

We investigate an associative memory model consisting of both self-oscillatory and non-self-oscillatory oscillators that store temporal patterns on relative phase differences between the oscillators. We numerically simulate this model and show that the speed of memory retrieval is enhanced with increase in the proportion of number of non-self-oscillatory elements. These results imply, from a viewpoint of neuroscience, that the presence of resting or down state of neurons facilitates an ability of memory retrieval.

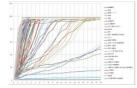## January 21 (Saturday), 13:00–15:10

Room D

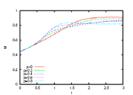## OS15 Information Technology for Environmental Research I

Chair: Takashi Yamaguchi (Tokyo University of Information Sciences, Japan)
Co-Chair: Kenneth J. Mackin (Tokyo University of Information Sciences, Japan)
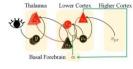
OS15-1 Network Analysis of Input-Output Table

Kousuke Yoshizawa, Xiang Gao, Shuhei Miyake, Naoko Sakurai,
Takeshi Fujiwara, Zeyu Zheng, and Kazuko Yamasaki
(Tokyo University of Information Sciences, Japan)

A "small world" is mentioned as one of the features of a complex network. Specifically, a "small world" is observed as "6 degrees of separation". That is, in a complex network, if at most six links are followed from a certain node on a network, (almost) all other node of networks can be reached. Verification of this character is easy in a binary network. However, verification of this character is not necessarily obvious for a directed-weighted network. It is because the distance between nodes changes by how the distance between nodes is defined. In this paper, an Input-Output Table, which expresses the relation between the industries in a certain area, was taken up as an example of a directed-weighted network. When using a suitable definition of a distance based on the money flow between industries, the character equivalent to this "6 degrees of separation" is observed.

January 21 (Saturday), 13:00–15:10

OS15-2   Network analysis of ecologocal footprint & CO2 emission based on Input-Output table for East Asia
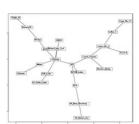
Xiang Gao, Takeshi Fujiwara, Naoko Sakurai, Kousuke Yoshizawa,
Syuhei Miyake, Zeyu Zheng, and Kazuko Yamasaki
(Tokyo University of Information Sciences, Japan)

We study the Input-Output table for East Asia as complex networks. The 50%~95% of sum of the off-diagonal elements is included in several percent of the big off-diagonal elements of the Input-Output table. This makes the network representation useful. We make the extracted networks with these big off-diagonal elements. The distributions of these off-diagonal elements (edge values) are power law shape with exponents of 2.56(money base), 2.07(EF base) and 2.00(CO2 emission base) on the average. EF base and CO2 base inter-dependences between industry sections are more unequal than money base, so from environmental point of view, a fewer inter-dependences are important. We can see the differences of the maximum 'degree', 'closeness' and 'the sum of elements (edge values)' in developed nations and in developing nations.

OS15-3   The fluctuation in Carbon emission trading Market

Zeyu Zheng, Naoko Sakurai, Takeshi Fujiwara, Kousuke Yoshizawa, and Kazuko Yamasaki
(Tokyo University of Information Sciences, Japan)

As an emerging financial market, the trading value of Carbon emission trading Market are definitely increased in recent years. The carbon emission is not only trading in Carbon emitters but also become an important investment target. For reveal the mechanism of this growing market, we analyzed the EU allowances (EUA) price series in European Climate Exchange (ECX), that is the leading European emissions futures market. As other financial market, the absolute value of price change (volatility) in Carbon emission trading Market also shows long-term power-law correlations. Our analysis shows that definite cross correlations exist between EUA and many other markets. These cross correlation exist in wild-range fields, stock market index, futures of crude, sugar, cocoa, etc. it suggest that in this new carbon emission trading market the speculation behavior had already become a main factor that can affect the price change.

January 21 (Saturday), 13:00–15:10

Room E

OS3 Bioinformatics

Chair: Shigeru Omatu (Osaka Institute of Technology, Japan)
Co-Chair: Hideo Araki (Osaka Institute of Technology, Japan)

OS3-1   Measurement system for metal oxide gas sensors

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

Study on smell sensing and classification has been developed for a long time by many ways. Most of these have been focused on bad smells, when factors of bad smells were known chemically. Many gas sensors have been developed to detect specific chemicals. Our purpose is to make a new measurement system of smell gases and to apply it to classification of many gases. The proposed system has many sensors in a chamber and detects some chemicals at the same time. Smells data are transmitted to an A/D converter in a host PC which can be used to analyze data to classify the smells. The system must classify not only kinds of smells but also densities of them. In this paper, we develop the measurement system for multi-channel sensors made of metal-oxide semiconductors with power supply circuits.

OS3-2   Smell classification by using metal oxide gas sensors
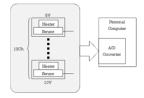
Sigeru Omatu and Hideo Araki
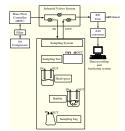(Osaka Institute of Technology, Japan)

In this paper, a reliable electronic nose (EN) system designed from the combination of various metal oxide gas sensors (MOGS) is applied to detect the early stage of fire from various sources. The time series signals of the same source of fire in every repetition data are highly correlated and each source of fire has a unique pattern of time series data. Therefore, the error back propagation (BP) method can classify the tested smell with 99.6% of correct classification by using only a single training data from each source of fire. The results of the k-means algorithms can be achieved 98.3% of correct classification which also show the high ability of the EN to detect the early stage of fire from various sources accurately.
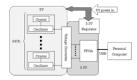
OS3-3   Measurement system for quarts crystal microbalance sensors

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

Human olfactory is examined for a long time and many ways. Olfactory is studied based on gas chromatography technology. These studies have used gas sensors made of metal-oxide semiconductors. The semiconductor-sensors can detect gases as difference of resistance by oxidation or reduction of surface on the sensor. Human olfactory is organized by about 2,000 receptors of smell, and many sensors are used to emulate by electric sensors. We consider to apply multi-channel QCM for these sensors, and build an evaluation system. However, QCM oscillators interfere each other in a system. QCM sensor needs a fine oscillation to detect a difference of an oscillation signal. To realize our propose system, we take measures to the anti-jammers. In this paper, we express these measures to realize an olfactory emulation system with QCM.

January 21 (Saturday), 13:00–15:10

OS3-4   Classification of mixed smells by using neural networks

Toru Fujinaka[1], Sigeru Omatu[2], and Hideo Araki[2]
([1]Hiroshima University, Higashihiroshima, Japan)
([2]Osaka Institute of Technology, Japan

Compared with metal oxide semiconductor gas sensors, quarts crystal microbalance (QCM) sensors are sensitive for odors. Using an array of QCM sensors, we measure mixed odors and classify them into an original odor class before mixing based on neural networks. For simplicity, we consider the case where two kinds of odor are mixed since more than two become to complex to analyze the classification results. We have used eight sensors and four kinds of odor are used as the original ones. The neural network used here is a conventional layered neural network. The classification is acceptable although the perfect classification could not been achieved.

Room F

OS6 Biomimetic Machines and Robots I

Chair: Keigo Watanabe (Okayama University, Japan)
Co-Chair: Kiyotaka Izumi (Saga University, Japan)

OS6-1   Proposal and implementation of CAM system for industrial robot RV1A

Sho Yoshitake[1], Fusaomi Nagata[1], Akimasa Otsuka[1], Keigo Watanabe[2], and Maki K. Habib[3]
([1]Tokyo University of Science, Yamaguchi, Japan)
([2]Okayama University, Japan)
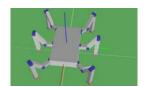([3]American University in Cairo, Egypt)

A CAM system for an articulated-type industrial robot RV1A is described from the viewpoint of robotic servo controller. It is defined here that the CAM system includes an important function that allows the industrial robot to move along cutter location data (CL data) consisting of position and orientation components. Another important point is that the proposed CAM system has a high applicability to other industrial robots whose servo systems are technically opened to end-user engineers. Our CAM system works as a straightforward interface without using any robot languages between CAD/CAM and industrial robots. Here, in order to raise the relationship between a conventional CAD/CAM and an industrial robot, a design and an implementation of CAM system are shown.

OS6-2   The adjustment of CPG parameters to realize continuous jumping movements for a six-legged robot
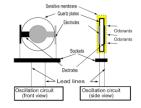
Masaaki Ikeda[1], Keigo Watanabe[1], and Kiyotaka Izumi[2]
([1]Okayama University, Japan)
([2]Saga University, Japan)

Central Pattern Generators (CPGs) as neural oscillators can determine a periodic motion state just like a walk. There exists a simple CPG for realizing the walk of an insect. It has been confirmed that a successive jump was able to be realized by applying such a simple structure. Furthermore, it was proved that different jumping appearances were generated according to the jumping-out posture, even if similar jumping generators were used. In this paper, for a CPG of a successive jumping six-legged robot, it is checked that parameters related to the CPG should be changed and optimized, depending on the jumping-out posture. A simple genetic algorithm is used as an optimization method. The simulation results that were obtained from a successive jumping simulation conducted by a dynamic simulator OpenHRP3, are used to evaluate the individuals in the GA.

January 21 (Saturday), 13:00–15:10

OS6-3   A proposal of experimental education system of mechatronics

Naoki Kitahara[1], Fusaomi Nagata[1], Akimasa Otsuka[1], Kaoru Sakakibara[2],
Keigo Watanabe[3], and Maki K. Habib[4]
([1]Tokyo University of Science, Yamaguchi, Japan)
([2]C-TASK Co., Ltd., Japan)
([3]Okayama University, Japan)
(American University in Cairo, Egypt)

Recently, many studies on educational system are being conducted. In this manuscript, a unique education system is proposed for mechanical engineers to be able to efficiently learn basic mechatronics techniques. The system is composed of three subsystems. The first system is used to learn input/output port operations, periodically LED lights ON/OFF and a stepping motor control. The second system is effective to learn AD transformation for several sensor information, DA transformation for DC motor control and a PID control method. Further, the third system is multiple mobile robots system to learn the subsumption architecture for schooling behavior. The effectiveness of the proposed systems was confirmed through experimental instructions in Tokyo University of Science, Yamaguchi.

OS6-4   A discontinuous exponential stabilization law for an underactuated X4-AUV

Zainah Binti Md. Zain[1], Keigo Watanabe[1], Kiyotaka Izumi[2], and Isaku Nagai[1]
([1]Okayama University, Japan)
([2]Saga University, Japan)

In this paper, stabilization of a class of second-order nonholonomic systems for an underactuated X4-AUV is investigated. We present a model of the underactuated X4-AUV with six degrees-of-freedom (DOF) and four control inputs. Then the system is written in a control-affine form by applying a partial linearization technique and a dynamic controller based on Astolfi's discontinuous control is derived to stabilize all states of the system to the desired equilibrium point exponentially. A simulation is conducted to demostrate the effectiveness of the proposed controller.

OS6-5   Eye-vergence visual servoing enhancing Lyapunov-stable trackability

Fujia Yu[1], Mamoru Minami[1], Wei Song[2], and Akira Yanou[1]
([1]Okayama University, Japan)
([2]University of Shanghai, Japan)

Visual servoing methods for hand-eye configuration are vulnerable for hand's dynamical oscillation, since nonlinear dynamical effects of whole manipulator stand against the stable tracking ability (trackability). Our proposal to solve this problem is that the controller for visual servoing of the hand and the one for eye-vergence should be separated independently based on decoupling each other, where the trackablity is verified by Lyapunov analysis. Then the effectiveness of the decoupled hand & eye-vergence visual servoing method is evaluated through simulations incorporated with actual dynamics of 7-DoF robot with additional 3-DoF for eye-vergence mechanism by amplitude and phase frequency analysis.

January 21 (Saturday), 15:30–16:45

Room B

OS21 Intuitive Human-System Interaction

Chair: Masao Yokota (Fukuoka Institute of Technology, Japan)
Co-Chair: Tetsushi Oka (Nihon University, Japan)

OS21-1　Gesture detection based on 3D tracking for multimodal communication with a life-supporting robot

Tetsushi Oka, Ryuuichi Kibayashi, and Hirosato Matsumoto
(Nihon University, Japan)

This paper reports some recent results from a study on multimodal communication between life-supporting robots and their users. In the study, novice users understood how to use four types of hand gestures, raising, lowering, pushing, and pulling in a short period of time. They successfully conveyed their intensions to a robot using gestures, after watching a video for four minutes that explained how to use gestures and practicing for less than four minutes. The robot guided the users by displaying messages on its front screen and detected gestures by tracking the user's head and right hand based on depth and color information. The results show that novice users can learn quickly how to convey intentions to our robot and imply that it is easy for untrained users to combine hand gestures and spoken messages, in order to make a robot to turn to them, move forward to them, back away, approach them, and so on.

OS21-2　Evaluation of some user interfaces for elderly persons

Sinichi Inenaga, Kaoru Sugita, and Masao Yokota
(Fukuoka Institute of Technology, Japan)

We have already proposed a new concept of 'universal multimedia access' intended to narrow the digital divide by providing appropriate multimedia expressions according to users' (mental and physical) abilities, computer facilities, and network environments. Our previous work has evaluated some types of multimedia user interfaces only for younger persons who can utilize keyword search functions. In this paper, we describe several multimedia contents particularly for elderly persons' aid and evaluate them based on a questionnaire survey.
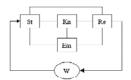

OS21-3　Toward artificial Kansei based on Mental Image Directed Semantic Theory

Tzu-Hsuan Huang, Kaoru Sugita, and Masao Yokota
(Fukuoka Institute of Technology, Japan)

The authors have proposed a human mind model of human mind consisting of Stimulus, Knowledge, Emotion and Response Processing Agents and simulated human-robot communication based on it. This paper proposes 'Artificial Kansei (AK)', namely, Kansei for a robot as tight collaboration of Knowledge and Emotion Processing Agents of our mind model, and considers its application to a Kansei information system for Buddhism statues made to order.

January 21 (Saturday), 15:30–16:45

OS21-4   A high-sensitivity 3-D shape measurement method with microscope

Xueli Zhang, Kazuhiro Tsujino, and Cunwei Lu
(Fukuoka Institute of Technology, Japan)

An optical microscope commonly has magnification from tens to thousands times, and is often used for observation of a micro specimen. The application of three-dimensional (3-D) shape measurement of specimen is broad, such as medical treatment, pharmacy, life science and materials science. On conventional methods, it must to regulate focus distance with great precision or operate by skilled personnel. In order to solve these problems, we propose a high-sensitivity 3-D shape measurement method with microscope. The measurement system is consisted of a microscope, line laser and computer can obtain high precision. The method is unnecessary to regulate focus distance with great precision, simply project laser source onto target and obtain reflection image with camera of microscope, use image processing to obtain center point of intensity distribution of it, finally calculate 3-D shape information based on triangulation method. The experimental results show proposal method is available.
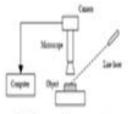

Fig.1 Microscope 3-D measurement system

OS21-5   Tele-immersive environment with tiled display wall for intuitive operation and understanding in remote collaborative work

Yasuo Ebara
(Osaka University, Japan)

In remote collaborative work via WAN, share various high-quality visual contents, and recognizing these contents clearly is extremely important. Supporting a high-quality display of these contents on a large-scale display system is necessary to support intellectual remote collaborative work. However, these contents are currently magnified in low resolution on a general projector using large-sized display equipment, and a sufficient quality of the contents is not obtained. In this paper, we have constructed a tele-immersive environment with tiled display wall, and have studied the availability for intuitive operation and understanding in remote collaborative work by implementing various collaborative applications for the effective display of high-resolution contents as well as developing interaction techniques for enormous visual contents in this environment. As a result, we have showed that the practical use of tiled display wall is useful in the construction of intellectual remote collaborative environment.

Room C

OS22 Management of technology

Chair: Takao Ito (Ube National College of Technology, Japan)
Co-Chair: Rajiv Mehta (New Jersey Institute of Technology, USA)

OS22-1   How does the network structure of standard-setter affect its standard-setting activity?

Kensuke Ogata
(University of Nagasaki, Japan)

This article aims to explain the following question: how does the network structure of standard-setters affect their performance? This paper focuses on the activities and structures of FASB and IASB.   It presumes that the standard-setters strategically alter the organizational structure and consequently change the activities.   To identify the structures, this paper uses coreness analysis in network theory.   According to the analyses, it follows as below.   First, the FASB has recognized the survival-crisis due to the rise of IASB.   Preventing from the crisis, the Board has sought to take alliances with the users and attempted to set lots of innovative standards.   Second, to reinforce its position as a global ruler, the IASB has needed to acquire the trust of global and local regulators as well as the businesses.   Then, the IASB has had to play as a coordinator with the preferences of broad constituencies and adopted the compromised standards slowly.

OS22-2   Simple model of economic Stability and Control

S. Lu[1] and Takao Ito[2]
([1]Shandong University in Weihai, P. R. China)
([2]Ube National College of Technology, Japan)

Stability is one of the important factors for system issues, such as economic structure, investment's decision, and government expenditures. We simplify the model of the stability and control for economic systems in this paper. Two important variables, GDP and investment, exists in the economic system. We build a model to identify the stability issue for the economic systems including these two variables. The stable control shows that the control should be inverse relation to the state of the systems. A system will be exploded after an immense control shock makes the system reach an unstable equilibrium state. It indicates that the government investments or expenditures should decrease instead of increase when the economic or government expenditure continues increasing.

OS22-3   An efficiency analysis using the ICB model in Mazda's Keiretsu

Seigo Matsuno[1], Takao Ito[1], Masayoshi Hasama[1], Rajiv Mehta[2], and Makoto Sakamoto[3]
([1]Ube National College of Technology, Japan)
([2]New Jersey Institute of Technology, USA)
([3]University of Miyazaki, Japan)

Performance—an indicant of corporate efficient and effectiveness—is determined by many different factors, such as economic environment and coordination of managerial resources. Only recently has performance, which is based on graph theory, been extended and analyzed to assess structural change of network organizations. Only a few indexes based on graph theory have applied and analyzed in most recent research to measure the structural changes of network organizations. In order to develop a rational model, this empirical research attempts to establish the inter-relational linkages among multiple corporate performance indices. Specially, this paper seeks to assess corporate efficiency using the DEA analysis. Accordingly, the contribution of this research is to propose a new way to build a quantitative model that identifies the efficiency of each individual firm in Mazda's Yokokai Keiretsu.

January 21 (Saturday), 15:30–16:45

OS22-4   A note on three-dimensional probabilistic finite automata

Makoto Sakamoto[1], Takao Ito[2], Xia Qingquan[3], Yasuo Uchida[2], Tsunehiro Yoshinaga[4],
Masahiro Yokomichi[1], Satoshi Ikeda[1], and Hiroshi Furutani[1]
([1]University of Miyazaki, Japan)
([2]Ube National College of Technology, Japan)
([3]Harbin Institute of Technology, P. R. China)
([4]Tokuyama College of Technology, Japan)

We think that recently, due to the advances in many application areas such as computer graphics, computer vision, image processing, robotics, and so on, it is useful for analyzing computation of three-dimensional information processing to explicate the properties of three-dimensional automata. From this point of view, we have investigated many properties of three- dimensional automata and computational complexity. On the other hand, the class of sets accepted by probabilistic machines have been studied extensively. As far as we know, however, there is no results concerned with three-dimensional probabilistic machines. In this paper, we introduce three-dimensional probabilistic finite automata, and investigate some accepting powers of them.

OS22-5   A Study on Factors Affecting the Degree of Bullwhip Effect and Inventory Cost to optimal management strategy for information Sharing in Supply Chains

Masayoshi Hasama[1], Seigo Matsuno[1], Takao Ito[1], Kouichi Saeki[1], and Yu Song[2]
([1]Ube National College of Technology, Japan)
([2]Fukuoka Institute of Technology, Japan)

To compete successfully in today's marketplace, it has become that success cannot rely solely on improving the efficiency of internal operations, and that collaboration with trading partners can build the foundation for a competitive advantage and substantially improve the bottom line. Companies need to efficiently manage the activities of design, manufacturing, distribution, service and recycling of their products, and services to their customers. The coordination and integration of these flows within and across companies are critical in effective supply chain management (SCM). In this paper, we define a two-stage supply chain model (a retailer and supplier). Based on results of simulations, we identify the factors

Room D

OS16 Information Technology for Environmental Research II

Chair: Takashi Yamaguchi (Tokyo University of Information Sciences, Japan)
Co-Chair: Kenneth J. Mackin (Tokyo University of Information Sciences, Japan)

OS16-1   Development of Stream Data Platform in Satellite Image Data Analysis System

Eiji Nunohiro, Hayao Mori, Masaki Hanada, Kenneth J Mackin, and Jong Geol Park
(Tokyo University of Information Sciences, Japan)

Tokyo University of Information Sciences receives MODIS data, one of the sensors equipped by NASA's Terra and Aqua satellites, and researches of the analysis on change of environment as part of the academic frontier project. For the information infrastructure of this frontier research, we are currently developing a satellite image data analysis system (SIDAS) implemented as a web system, with parallel distributed system configuration using multiple PC clusters, database for MODIS data, and applications to analyze the environmental changes. SIDAS is used to open the research results and MODIS data for public use. In this research, we are developing SIDAS 1.2 using the previously developed SIDAS 1.1 as the basic system. The main feature of SIDAS1.2 is the function of stream data processing, used to analyze the influence of the East Japan Earthquake and the monitor the regrowth of vegetation for the tsunami-stricken area in Tohoku region.

January 21 (Saturday), 15:30–16:45

OS16-2 Flood risk assessment using MLSWI by MODIS Time Series data

Jonggeol Park[1], Youngjoo Kwak[2], and Eiji Nunohiro[1]
([1]Tokyo University of Information Sciences, Japan)
([2]International Center for Water Hazard and Risk Management, Japan)

The principal purpose of this study is to describe the development and validation of an algorithm to estimate the fraction of water area within 500-m of the Moderate Resolution Imaging Spectroradiometer (MODIS) operating on the Earth Observation System Terra spacecraft. The result of this study is shown to be effective in determine the flood areas accurately in emergency response efforts as soon as possible. Estimation of a flood periphery is important to determine a fundamental hazard for risk management. This study was to accurately extract the spatial distribution of nation-wide flood risk using MODIS time series images and estimate simple algorithm for computing the flood inundation depth using Digital Elevation Model(DEM), flow direction and river network. The authors improved the accuracy of the water extent boundary using flood inundation depth (FID) data from a one year time-series of MODIS data.

OS16-3 Application of transfer learning to PSO for similar image search
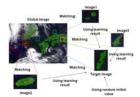
Kazuma Mori, Takashi Yamaguchi, Kenneth J. Mackin, and Yasuo Nagai
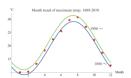(Tokyo University of Information Sciences, Japan)

Remote sensing of the earth surface using satellite monitored sensor data is one of the most important methods for global environmental monitoring. For satellite monitored sensor data, MODIS (Moderate Resolution Imaging Spectoradiometer) satellite data is actively used for the remote sensing data. In remote sensing fields, similar image search which extracts local area images from a given global map image is often required. Similar image search is important because physical changes to the earth's surface caused by human or nature can be monitored. However, long calculation time is required for similar image search in MODIS data due to the very large search space. In our previous research, an effective result was yielded using genetic algorithm on the similar image search from the satellite image. Based on this result, we proposed a particle swarm optimization based search method that globally searches for the problem space using particle groups.

OS16-4 The maximum and minimum temperatures trends in Oita

Masao Igarashi[1], Takahiro Yamazaki[1], and Eiji Nunohiro[2]
([1]Nihon University, Japan)
([2]Tokyo University of Information Sciences, Japan)

Japan Meteorological Agency has provided various kinds of historical temperature data of local meteorological station, such as Oita since February 1887. The provided temperature data contain the maximum, the minimum and the mean records on 17 leading and 57 local meteorological stations. We apply a nonlinear curve to the datasets and estimate the trends of the maximum, the minimum and the mean temperature, especially in Oita, by a numerical iteration method.

January 21 (Saturday), 15:30–16:45

Room E

OS11 Control Application

Chair: Osamu Sato (University of Miyazaki, Japan)
Co-Chair: Nobuya Takahashi (University of Miyazaki, Japan)

OS11-1 Acquisition of rules for selecting suppliers of raw materials in distributed production systems by means of reinforcement learning

Hisaaki Yamaba, Kayoko Takatsuka, and Shigeyuki Tomita
(University of Miyazaki, Japan)

In these days, many production systems are consist of several factories. Such factories are dispersed in wide area and form "production networks." In such networks, each factory produces intermediate materials for other factories. In order to operate production networks efficiently, some rational and sound operational strategy is needed for realizing cooperative operation. In the previous work, "Behavior Model" of scheduling activities in decentralized production networks was developed and the validity was confirmed. Also, an attempt was made to obtain proper scheduling rules by means of reinforcement learning. Concretely, Profit Sharing was adopted in order to obtain rules for selecting suppliers of intermediate materials under the proposed operational model. In this work, improvement of the representation of states used in the rule learning was attempted. A series of experiments was carried out in order to examine the performances of the rules obtained under the new representations.

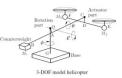### OS11-2 Analysis of manipulator in consideration of impact absorption between link and object

Asaji Sato[1], Osamu Sato[2], Nobuya Takahashi[2], and Masahiro Yokomichi[2]
([1]Miyakonojo National College of Technology, Japan)
([2]University of Miyazaki, Japan)

In this paper, equations of motion of a manipulator are derived in consideration of characteristics of driving source. Considering the impact force absorption between the link and object, trajectories for saving energy are calculated by iterative dynamic programming. And, the dynamic characteristics of manipulator controlled based on the trajectory for saving energy are analyzed theoretically and investigated experimentally.

OS11-3 An application of guaranteed cost control to a 3-DOF model helicopter

Erwin Susanto, Tatsuhiro Tamura, Mitsuaki Ishitobi, and Sadaaki Kunimatsu
(Kumamoto University, Japan)

This paper deals with guaranteed cost control for a model helicopter which has 3-DOF (degree of freedom): the elevation, pitch, and travel angles. One of main difficulties in designing a feedback controller for the helicopter is that the model includes nonlinearities. In this paper, these nonlinearities are considered as the uncertainty terms. Guaranteed cost control is applied not only to achieve the closed-loop stability but also to guarantee an adequate level of performance of the nonlinear 3-DOF model helicopter. A numerical example is shown to illustrate the effectiveness of the proposed method.

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January 21 (Saturday), 15:30–16:45

OS11-4   Robust control of a three-link RRR manipulator with structured uncertainty

Nobuya Takahashi, Yoshiaki Nakamura, and Osamu Sato
(University of Miyazaki, Japan)

In the framework of the linear control system theory, the design procedure for the controller is archived by a model based method. But the numerical model only contains a nominal characteristic of the plant. Thus, it is important problem to obtain the representation of the effect of the uncertainty, and use this information for the design of robust controller.
In this paper, we propose a modeling method for an uncertain system of a three-link RRR manipulator. We consider that each rotation joint of this manipulator consists a nominal joint angle and uncertain joint angle. Though, the uncertainty is treated as disturbance in the system that is maximum possible value of the uncertain joint angle. A relationship between disturbance and the system structure in a state equation is clarified. Through the numerical example, we show the effectiveness of our proposed method. It can apply our result to the general method of the robust control with structured uncertainty, such as guaranteed cost control.

OS11-5   Obstacle avoidance of snake robot by switching control constraint

Yasunobu Hitaka and Toshikazu Yoshitake
(Kitakyushu National College of Technology, Japan)

In this paper, we propose an obstacle avoidance strategy for the autonomous locomotion control of a snake robot with passive wheels. By using a general pass planning method for the head position control, it will be a complicated problem and the robot will have to take a circuitous path because any parts of the robot (from head to tail) must avoid contact with the obstacle. Our strategy is transformation of a periodic undulate gliding form for the robot to keep go straight without any collision with the obstacle. It is actualized by switching a control constraint imposed on the head of the robot. In this paper, we denote the detail of our strategy and investigate the effectiveness of our strategy by numerical simulations.

Room F

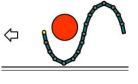## OS7 Biomimetic Machines and Robotics

Chair: Keigo Watanabe (Okayama University, Japan)
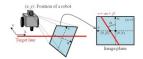Co-Chair: Kiyotaka Izumi (Saga University, Japan)

OS7-1   Image-based fuzzy trajectory tracking control for four-wheel steered mobile robots

Tatsuya Kato, Keigo Watanabe, and Shoichi Maeyama
(Okayama University, Japan)

A four-wheel steered mobile robot is fit for a higher power or improvement in the movement speed of a robot than a two-independent wheeled one. Since a steered mobile robot that slips very often cannot apply a popular dead-reckoning method by using rotary encoders, it is desirable to use external sensors such as cameras. This paper describes a method to trace a straight line for four-wheel steered mobile robots by using an image-based control method. Its controller is designed as a fuzzy controller and evaluated through some simulations and real robot experiments.

January 21 (Saturday), 15:30–16:45

OS7-2 Study on mobile mechanism of a climbing robot for stair cleaning-A translational locomotion mechanism and turning motion to be faced to a stair-

Takahisa Kakudou, Keigo Watanabe, and Isaku Nagai
(Okayama University, Japan)

In human living environments, it is often the case that the cleaning area is three-dimensional space such as a high-rise building. An autonomous cleaning robot is proposed so as to move on all floors including stairs in a building. The proposed robot is a body frame of a rectangular solid, which is equipped with L-shaped legs on the both sides and drive wheels on the top and bottom sides. The proposed robot climbs down stairs by rotating the body using L-shaped legs and it moves on smooth surfaces using wheels. In this paper, a mobile mechanism and a control method are described for translational locomotion. The operational check of the translational mechanism was conducted by facing the robot to the edge of stairs using the position sensitive detector (PSD).

OS7-3 The experiment of the path planning to respect human movements using a human frequency map for a mobile robot

Kimiko Motonaka, Shoichi Maeyama, and Keigo Watanabe
(Okayama University, Japan)

A robot requires any path planning to respect human movements when the robot works with the person in an environment. Therefore, we use a "Human Frequency Map (HFM)" generated by using observed human positions. By applying the HFM, the robot can achieve the path planning that cares about the human movements and the pathway width. In this paper, the case that the robot runs based on the path planning using the HFM is simulated in a living environment. Additionally, the path planning by using the HFM is compared with that not using the HFM to prove the availability of the HFM.

OS7-4 A study of tipping stability for omnidirectional mobile robot with active dual-wheel caster assemblies

Muhammad Juhairi Aziz Safar, Keigo Watanabe, Shoichi Maeyama, and Isaku Nagai
(Okayama University, Japan)

A holonomic omnidirectional mobile robot is well known for a high mobility and capability in maneuvering. In our approach, the holonomic omnidirectional mobile robot was developed using two active dual-wheel caster assemblies with conventional tires. In this paper, we are focusing on the stability issues in the tipping problem that may occur in the existing of static and dynamics environment. We derived the dynamic model of the omnidirectional mobile robot to estimate the supporting force at each wheel and evaluate it through simulations.

OS7-5 Unscented transformation for a FastSLAM framework

Saifudin Razali, Keigo Watanabe, and Shoichi Maeyama
(Okayama University, Japan)

This paper proposes an uscented transformation for a FastSLAM framework. The unscented transformation is used to estimate robot's poses in conjuction of generic particle filter used in standard FastSLAM framework. This method can estimate robot's poses more consistently and accurately than the use of single standard particle filters, especially when involving highly nonlinear models or non-Gaussian noises. In addition, our algorithm avoids the calculation of the Jacobian for motion model which could be extremely difficult for high order systems. Simulation results are shown to validate the performance goals.

Room H

Poster Session

Chair: Ju-Jang Lee (KAIST, Korea)
        Masatoshi Nakamura
            (Research Institute of Systems Control, Saga University, Japan)
        Peter S. Sapaty (National Academy of Sciences of Ukraine, Ukraine)

PS1-1   An intelligent human behavior based automatic accessing control system

ChinLun Lai
(Oriental Institute of Technology, Taiwan)

In this paper, an innovative intelligent controlling system for automatic door accessing is proposed to improve the drawback of frequent false actions among the existing control systems, while increasing the added values for extra security applications. Through pattern recognition techniques, the proposed system can precisely identify those people with intention of entering and/or leaving the door, and then control opening and closing of this door as a response. The experimental results indicate that our system has the advantages such as high precision, high reliability, and controllability in response to demands. In addition, the product prototype also has the economic benefits of low costs, high added-value, etc. Thus, it is a highly competitive new product.
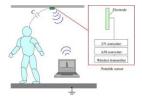
PS1-2   Non-contact physical activity estimation method based on electrostatic induction technique

Koichi Kurita
(Kochi National College of Technology, Japan)

We here present a method for measuring human physical activity, which is based on detecting the electrostatic induction current generated by the walking motion under non-contact and non-attached conditions. A theoretical model for the electrostatic induction current generated because of a change in the electric potential of the human body is also proposed. By comparing the obtained electrostatic induction current with the theoretical model, it becomes obvious that this model effectively explains the behavior of the waveform of the electrostatic induction current. The normal walking motions of daily living are recorded using a portable sensor measurement located in an ordinary house. The obtained results show that detailed information regarding physical activity such as a walking cycle can be estimated using our proposed technique. This suggests that the proposed technique, which is based on the detection of the walking signal, can be successfully applied to the estimation of human physical activity.

PS1-3   Genetic algorithm with cross paths detection for solving traveling salesman problems

Shi-Jim Yen[1], Shih-Yuan Chiu[2], and Sheng-Ta Hsieh[1]
([1]National Dong Hwa University, Taiwan)
([2]Oriental Institute of Technology, Taiwan)

The travelling salesman problem (TSP) is a classic optimization whose goal is to find a shortest route path. In this paper, an improved GA is proposed to solving TSP. For eliminating repeated chromosomes and increasing their diversity, a normalization strategy is proposed. Further, for improving solution searching efficiency, the cross paths detection is also proposed to reduce paths distance. Experiments were conducted on 10 instances of TSPLIB. The results showed that the proposed method exhibits better performance when solving these TSP instances compared to related TSP approaches.

January 20 (Friday), 12:40-13:40

PS1-4   Development of a mechanical safety device for service robots

Yoshihiro Kai[1] and Tatsuya Adachi[2]
([1]Tokai University, Japan)
([2]Daitocacao Co., LTD., Japan)

In this paper, we present a new safety device to improve the safety of service robots for humans. The safety device consists of only mechanical components without actuators, controllers and batteries. The safety device is attached to each drive-shaft of a robot and locks the drive-shaft after detecting an unexpected robot motion on the basis of the drive-shaft's angular velocity. First, we present the design concept of the safety device. Second, we explain the mechanism of the safety device. Third, we show the developed safety device. Fourth, we experiment by using the developed safety device. Finally, from the experimental results, we discuss the usefulness of the safety device.

Fig. Characteristics of the safety device

PS1-5   Improvement by the image processing of the certification of a reconstructed image from Computer-Generated Hologram picked up by digital watermark

Yuki Hirama and Ken-ichi Tanaka
(Meiji University, Japan)

Computer Generated Hologram (CGH) is made for three dimensional image of a virtual object that difficult to illuminate laser light directly. Even if this CGH deteriorate, it has characteristic that reconstruct is possible. This is a characteristic called the multiplexing that Fourier transform has. This characteristic is paid attention for the purpose of embedding this CGH as digital watermark because it is necessary to deteriorate this CGH. The purpose of this study is to make a computer authenticate CGH which we embedded it as digital watermark and took it out and regenerated. The method of the certification is Phase Only Correlation (POC). This study succeeded in improving the value of this evaluation.

PS1-6   Improvement of digital halftoning

Hiroki Takekawa and Ken-ichi Tanaka
(Meiji University, Japan)

When the image is displayed in the device that there is a limitation in the number of colors and the density value, the half tone processing is a needless technology. Several techniques like the dither method and the error diffusion method[1], etc. are proposed as a well known halftoning. The image evaluation of the processing image by the error diffusion method is superior compared with dither methods. Though, the processing image by the error diffusion method has visual problem. The blur is generated in the edge area. The noise of the striped pattern is generated in area that is low level value change of pixel. This paper, consider improvement the processing image by applying error diffusion algorithm with edge enhancement to using error coefficient corresponding to step edge. It is found that proposed technique process high quality halftoning image compared with error diffusion algorithm with edge enhancement.

January 20 (Friday), 12:40-13:40

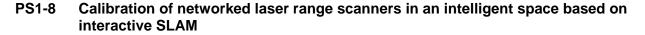### PS1-7   An improved differential evolution for solving large scale global optimization

Sheng-Ta Hsieh[1], Shih-Yuan Chiu[2], and Shi-Jim Yen[2]
([1]Oriental Institute of Technology, Taiwan)
([2]National Dong Hwa University, Taiwan)

Differential evolution (DE) is a population-based optimization algorithm. The members of population in DE are called parameter vectors. Due to more real-world optimization problems become increasingly complex. Algorithms with more ability and efficiency for searching potential solution are also increasing in demand. Thus, in this paper, an improved DE is proposed for solving large scale global optimization. The proposed method is incorporated with the population manager to eliminate redundant parameter vectors or to hire new ones or to maintain population size according to the solution searching status to make the process more efficient. The proposed method also involves mutation and cross-over for prevent the solutions from falling into the local minimum and enhance searching ability.

PS1-8   Calibration of networked laser range scanners in an intelligent space based on interactive SLAM
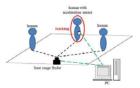
Fumitaka Hashikawa and Kazuyuki Morioka
(Meiji University, Japan)

For human-robot coexistent environments, intelligent spaces including networked laser range sensors, cameras and the other sensing device have been developed. So, we consider the intelligent spaces with Fast-SLAM based on Particle Filter. Especially, on the map construction based on a grid map is more accurate than normal SLAM. However, those methods use only sensing data from the mobile robot to achieve SLAM. In this study, a new method of SLAM, which uses distributed sensors fixed in an environment as intelligent space, is introduced. This method shares information with SLAM of mobile robot. And we introduce calibration method of distributed sensors.

PS1-9   Development of person identification and tracking system with wearable acceleration sensors in intelligent space

Tomoyasu Takigawa and Kazuyuki Morioka
(Meiji University, Japan)

This paper proposes a human identification and tracking system with a wearable acceleration sensor and networked laser range scanners in an intelligent space. Human walking activities are measured and associated between laser range scanners and acceleration sensor. In this paper, a proposed person identification system between two types of sensors is described. A module of each sensor is implemented as RT component. The proposed distributed sensor system was developed by integrating these RT components. Information on walking behavior of human is communicated between components and shared in this system. Some experimental results with this system show a possibility of person identification and tracking.

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PS1-10　Development of easy camera calibration tool under unified world coordinate system using online three-dimensional reconstruction

Shintaro Kuroiwa and Kazuyuki Morioka
(Meiji University, Japan)

Three-dimensional position information is essential in order to give appropriate support for human beings in an intelligent space. Distributed cameras in the intelligent space have to be calibrated geometrically for acquisition of three-dimensional position. Since calibration of many cameras is time-consuming, camera calibration methods for easy construction of the intelligent space are needed. This paper proposes camera calibration support system based on image features and 3D information by portable calibrated cameras. Image features and 3D positions are shared with uncalibrated cameras via network, and these cameras are calibrated with common image features. In this paper, the details of the developed system are described and experimental results are introduced.

PS1-11　Development of a multi-purpose compact board for robot control systems

Mitsuhiro Yamano[1], Shinya Takeda[1], Yuichi Suzukawa[2], and Yu Kakuta[1]
([1]Yamagata University, Japan)
([2]UD Trucks, Japan)

This paper presents development of a multi-purpose compact board for robot control systems and its applications. Advanced robot system with many actuators and sensors require complicated control system. Different sensor has different specification of signal output. Advanced robots have to accept many kinds of signals. Prototype robots in the laboratory are often extended and modified for the research. Common computer hardware for many kinds of actuators and sensors contributes to the efficiency of its software development. We have developed the multi-purpose Micro Control Unit (MCU) board that can be used for many kinds of actuators and sensors. The MCU board is designed so that it can be used for many devices and many applications. Two applications of the MCU board are presented to show its effectiveness.

PS1-12　'Cruise-and Collect' algorithm for an ARM-based autonomous robot

Mohd. Noh Zarina, Md. Salim Sani Irwan, Mohamad Yatim Norhidayah, Ali Nur Alisa, and Mohd. Said Muzalifah
(Universiti Teknikal Malaysia Melaka, Malaysia)

The 'cruise-and-collect' algorithm proposes in this research is intended to be applied for an autonomous robot system. The robot is designed to be used in a sport such as table-tennis, to help the players collect the off-side ball during a game. The controller for the robot system will utilize ARM-based microcontroller chip from Atmel, AT91SAM7S128, as it is the classic ARM7TDMI processor that had marked a great success of ARM processor market. The algorithm is developed via Flowcode software which exploits the flowchart as its design entry. The E-block board that has an integrated microcontroller chip is used for the purpose of its hardware prototype and software testing. It is hoped that the development and design process exposed in this research will be benefitted for researchers who are interested in the area of prototype development and robot design, especially via the ARM7TDMI processor platform.

PS1-13 Blood vessel extraction for diabetic retinopathy

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([2]King Saud University, Saudi Arabia)
([3]University of Malaya, Malaysia)

Diabetic retinopathy is an eye problem that face by the diabetic's patient. Diabetic Retinopathy (DR) is caused by the changes of the blood vessel in the retina. In the early stage of DR, the blood vessels may swell and leak fluid. However, in the advance stage of DR a new blood vessel that fragile and abnormal may formed and leaks blood to the retina. This can caused vision loss or even blindness. Therefore, this paper proposed to extract the blood vessel based on the peak and valley detection. The proposed methods utilized a green channel image and the inversion image. Next, the resulting images from both methods are combined. Three (3) databases are utilized namely from STructured Analysis of the Retina (STARE), Digital Retina Images for Vessel Extraction (DRIVE) and a database that is acquired from the local hospital.

PS1-14 Decision tree approach for fault diagnosis of nonlinear systems

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([2]University of Massachusetts Lowell, USA)
([3]Korea Electronics Technology Institute, Korea)
([4]Dongguk University, Korea)

In this paper we proposed a decision tree approach for fault diagnosis of nonlinear systems using tree model CART (classification and regression trees) and MNN (multilayer neural network). In the proposed method, the fault is detected when the errors between the actual system output and the NN nominal system output cross a predetermined threshold. Once a fault in the nonlinear system is detected, CART is used for classifying the fault.
  The algorithm contains two main parts: a fault detection part by threshold test based on neural network, and a fault classification part by tree model CART. The decision tree is proficient at both maintaining the role of dimensionality reduction and at organizing optimally sized classification trees, and therefore it could be a promising approach to diagnose a fault which is occurred in the nonlinear systems.

PS1-15 A design of a cost effective Fire Fighting Robot using intelligent system

Shuddha Chowdhury[1], Shuva Paul[1], and Istiaque Islam[2]
([1]American International University Bangladesh, Bangladesh)
([2]Islamic University of Technology, Bangladesh)

We usually read in newspapers about fire accidents and rising death toll rates because of fire related accidents. At times even firemen lose their lives while on rescue operations. We have proposed a model Fire Fighting Robot which has been designed for relief operations with main focus on rescue purposes. Use of robots is growing both on Earth and in space, in large part due to increased capacity for machine intelligence. Robotics defined as a mechanical design that is capable of performing human tasks or behaving in a human-like manner. The Robot is an electrically powered and remotely controlled unmanned vehicle. It is a battery-operated robot on wheels and its primary role is to detect the source of heat and put off flames.

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PS1-16   Gait analysis using inertial sensor and vision

Tri Nhut Do and Young Soo Suh
(University of Ulsan, Korea)

In this paper, a novel method is proposed to analyze the gait using inertial sensor and vision technique. An indirect Kalman filter is used to estimate step length and foot angles. The vision technique provides us vision information which is used to update the Kalman filter. A measurement unit including a camera and inertial sensors is mounted on a shoe. The vision information including position and attitude of a shoe is estimated based on a simple planar landmark system which consists of thousands of markers and be easily expandable. Experiments verify our proposed system is quite accurate, especially in step length measurement. This proposed system is suitable for long distance applications