ABSTRACTS

Invited Session on Playware (Room F)

January 30 (Wednesday), 13:00–15:30

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

ISP1 Effect of Playful Balancing Training – A Pilot Randomized Controlled Trial

Henrik Hautop Lund and Jari Due Jessen
(Centre for Playware, Technical University of Denmark, Denmark)

We used the modular playware in the form of modular interactive tiles for playful training of community-dwelling elderly with balancing problem. During short-term play on the modular interactive tiles, the elderly were playing physical, interactive games that were challenging their dynamic balance, agility, endurance, and sensor-motoric reaction. A population of 12 elderly (average age: 79) with balancing problems (DGI average score: 18.7) was randomly assigned to control group or tiles training group, and tested before and after intervention. The tiles training group had statistical significant increase in balancing performance (DGI score: 21.3) after short-term playful training with the modular interactive tiles, whereas the control group remained with a score indicating balancing problems and risk of falling (DGI score: 16.6). The small pilot randomized controlled trial suggests the playful interaction with the modular interactive tiles has a significant effect even after a very short time of play. The average total training time to obtain the statistical significant effect amounted to just 2h45m.

ISP2 Engaging through her eyes
Embodying the perspective of a robot companion

Patrizia Marti[1], Jelle T. Stienstra[12]
([1]Social, Political and Cognitive Science Department, University of Siena, Italy)
([2]Department of Industrial Design, Eindhoven University of Technology, Netherlands)

In response to a change in the use of computers and interactive technologies, traditional Human-Computer Interaction concepts of usability, efficiency and productivity have progressively been enriched with other concepts such as curiosity, empathy, playfulness and affection [1]. Korhonen et al. [2] state that the acceptance of a product depends not only on its utilitarian properties but also on non-utilitarian ones including playfulness. However, even if there seems to be near consensus on the importance of designing interactive systems beyond rational and functional requirements, the way in which this can be achieved is still an open research issue. In this paper we describe our design approach to develop an embodied and playful mobile interface to control a robot companion in a smart home environment.

A major challenge of the research is to engage an older person in rich, empathic and playful interaction with a robot to encourage a prolonged, subtle, and stimulating effect beyond the initial encounter [3]. This challenge is explored through the design of innovative concepts of playful interaction embodying the perspective of the robot companion.

ISP3 Fable: Socially Interactive Modular Robot

Arnþór Magnússon, Moises Pacheco, Mikael Moghadam, Henrik H. Lund, David J. Christensen
(Technical University of Denmark, Denmark)

Modular robots have a significant potential as user configurable robotic playware, but often lack sufficient sensing for social interaction. We address this issue with the Fable modular robotic system by exploring the use of smart sensor modules that has a better ability to sense the behaviour of the user. In this paper we describe the development of a smart sensor module which includes of a 3D depth camera, and a server-side software architecture featuring user tracking, posture detection and a near-real-time facial recognition. Further, we describe how the Fable system with the smart sensor module has been tested in educational and playful contexts and present experiments to document its functional performance.

January 30 (Wednesday), 13:00–15:30

ISP4 bioToys: biofeedback device for physiotherapy using building blocks

Tomoya Shimokakimoto, Asaki Miura, Kenji Suzuki
(University of Tsukuba, Japan)

In the field of physiotherapy for children with impaired motor function or congenital loss of limbs, physical therapists (PT) assist children to recover the motor function or to adapt to the use of artificial limbs controlled by Electromyography (EMG). However, children easily give up training on use of artificial limbs because it becomes boring after a while. Generally, training contents are simple tasks such as picking up and moving candies or tying a knot in a towel using the artificial arm. In contrast, the PT tries to tune the gain parameters of EMG and artificial limb so as to deal with differences among individuals. They should check EMG signals, artificial limb movement and tune them at the same time. It is also important for children to feel excited with therapeutic activities and the system should be easily handled by the PT.
In this research, we propose a building block like biofeedback toys called "bioToys". This system enables the use of biological or physiological signals in input blocks and generates various outputs such as motion, vibrations, sounds and illuminations. We implemented this system on the DUPLO (The LEGO Group). This system is constructed based on seven types of blocks: battery, sensing (physiological and biological), wireless, parameter control, normal, extension and output. The biofeedback system is constructed by arranging and rearranging these building blocks easily by users or PTs to make physical shapes

Invited Speeches (Room F)

January 31 (Thursday), 13:15–14:15

IS1 Future Technology and Market Developments for Unmanned Maritime Vehicles

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

A novel high-level ideology and technology will be revealed that can effectively create, support, and manage highly integral distributed systems of physical, virtual or combined nature. These systems, despite potentially distributed over large spaces and operating without central control, can express global consciousness, awareness and will similar to living organisms, as well as capability of self-analysis, self-evolution, and self-recovery from indiscriminate damages in complex environments. The paradigm, called Spatial Grasp Technology (SGT), differs drastically from traditional approaches which first create a system structure from predetermined pieces, or agents, establish subordination and control over the latter, and then try to get needed global behavior [1]. Such systems are often static, fail to adapt to dynamic and asymmetric situations, and may have to be redesigned and reassembled if initial goals change, with considerable loss of productivity. SGT, pursuing holistic and gestalt ideas [2-4] rather than agents-based, starts from the opposite side, formalizing from the very beginning the global system goal, main function to achieve it, and if needed, overall behavior in a special high-level Spatial Grasp Language (SGL) while delegating most of traditional routines of system composition, structuring, and internal command and control to automatic levels, during formal SGL interpretation. The SGL scenarios, initially injected into any system point, dynamically spread, cover, and organize any available human and/or robotic resources with any communications between them into goal-driven operational systems. Details of SGT and its implementation in distributed environments will be revealed where copies of communicating SGL interpreters can be embedded into main points of the resources to be organized as a controlled system, including stealth applications in hostile environments. System creation and mission scenarios in SGL can be on a variety of levels (also any mixture of them) -- from top semantic (like global task definition) -- to abstracted system organizations -- to detailed structures with internal control. Examples of creation of distributed systems with arbitrary topologies, inhabiting them with active mobile objects interacting with each other and with the system infrastructure and external environment, setting global supervision over system's behavior, structure to structure pattern matching, also controlled runtime evolution and self-recovery will be demonstrated. Already researched and planned applications of SGT will be outlined, which comprise massive cooperative robotics (including swarming and swarm-against-swarm fights), solving demographic problems (like robotized elderly support), crisis and disaster management, as well as security and protecting critical infrastructures and key resources [5-10].

January 30 (Wednesday), 10:00–11:45

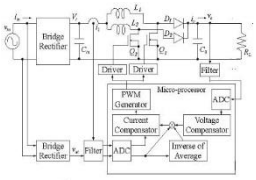
Room A

OS6 Control in Mechatronics and Power Electronics

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

OS6-1 Robust Digital Control for Interleave PFC Boost Converter

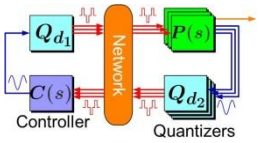
Yuto Adachi[1], Kohji Higuchi[1], Tatsuyoshi Kajikawa[1], Tomoaki Sato[2], Kosin Chamnongthai[3]
([1]The University of Electro-Communications, Japan)
([2]C&C SYSTEMS CENTER Hirosaki University, Japan)
([3]King Mongkut's University of Technology Thonburi, Thailand)



In recent years, improving of power factor and reducing harmonic distortion in electrical instruments are needed. In general, a current conduction mode boost converter is used for active PFC (Power Factor Correction). Especially, an interleave PFC boost converter is used in order to make a size compact, make an efficiency high and make noise low. In this paper, a robust digital controller for suppressing the change of step response characteristics and variation of output voltage at a load sudden change with high power factor and low harmonic is proposed. Experimental studies using a micro-processor for controller demonstrate that this type of digital controller is effective to improve power factor and to suppress output voltage variation.

OS6-2 Synthesis of continuous-time dynamic quantizers for LFT type quantized feedback systems

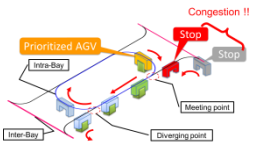
Kenji Sawada, Seiichi Shin
(The University of Electro-Communications, Japan)



This paper focuses on analysis and synthesis methods of continuous-time dynamic quantizers for LFT type quantized feedback systems. Our aim is to find multiple (decentralized) quantizers such that a given linear system is optimally approximated by the given linear system with the quantizer in terms of invariant set analysis. In the case of minimum phase systems, this paper clarifies that optimal dynamic quantizers and its performance are parameterized by a design parameter. Also, an analytical relation between the static and dynamic quantizers will be presented.

OS6-3 Optimal scheduling of automatic guided vehicle transportation system based on MLD system modeling

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



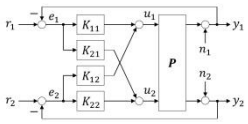
This paper proposes an optimal scheduling method of transportation systems in semiconductor manufacturing within MLD (mixed logical dynamical) modeling framework. We consider an optimal scheduling problem of AGV (automatic guided vehicle) system transfer problem, which is to control the AGV congestion around the meeting points and the dividing points of the transportation road in this paper. The problem is recast as an ILP (Integer Linear Programming) problem within model predictive control framework.

January 30 (Wednesday), 10:00–11:45

OS6-4 Direct Multivariable PI Controller Tuning from Closed-Loop Response Data

Yosihiro Matsui[1], Hideki Ayano[1], Kazushi Nakano[2]
([1]Tokyo National College of Technology, Japan)
([2]The University of Electro-Communications, Japan)

This paper proposes a PI controller tuning method for multivariable plants. The method requires only one set of the input-output transient data of the plant under closed-loop operation to tune the controller. The data is used to obtain an appropriate controller parameter by solving a model matching problem of FRIT (Fictitious Reference Iterative Tuning) in time domain, and the data is also used in frequency domain to confirm if the parameter tuned by FRIT is stable and if the model matching is achieved. The method is applied to a non-interacting control of a gas turbine engine and its effectiveness is shown through simulations.



OS6-5 On inhibition of premature convergence in Genetic Algorithms for mobile robot Control

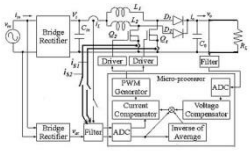
Satoshi Shintaku, Kazushi Nakano
(The University of Electro-Communications, Japan)

Methods of Evolutionary Robotics using the evolutionary computation has been applied to design of mobile robot controllers. Genetic algorithms (GAs), ones of the typical methods in the evolutionary computation, have advantages that hardly fall into local minima compared to the other optimization algorithms. However the GAs have a big problem of premature convergence that the variety of the population is reduced, so the searching ability is degraded. In this study, through analysis of a new individual generation in GAs, we propose two methods of Probabilistic Crossover and Fluctuant Mutation to inhibit the premature convergence. We apply our proposal methods to benchmark problems in optimization and to controller design of the peg pushing robot, and demonstrate the effectiveness of our proposed methods.

OS6-6 Digital PI control for Interleave PFC boost converter

Yuto Adachi[1], Kohji Higuchi[1], Tatsuyoshi Kajikawa[1], Tomoaki Sato[2], Kosin Chamnongthai[3]
([1]The University of Electro-Communications, Japan)
([2]Hirosaki University, Japan)
([3]King Mongkut's University of Technology Thonburi, Thailand)

In recent years, improving of power factor and reducing harmonic distortion in electrical instruments are needed. In general, a current conduction mode boost converter is used for active PFC (Power Factor Correction). Especially, an interleave PFC boost converter is used in order to make a size compact, make an efficiency high and make noise low. In this paper, a PI digital controller for suppressing the change of step response characteristics and variation of output voltage at a load sudden change with high power factor and low harmonic is proposed. Experimental studies using a micro-processor for controller demonstrate that the PI digital controller is effective to improve power factor and to suppress output voltage variation and is more advantageous to control the current of the sum of each phase in hardware.



January 30 (Wednesday), 10:00–11:45

Room B

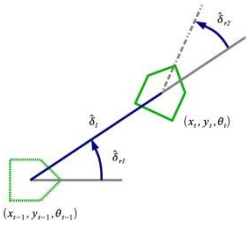
OS3 Biomimetic Machines and Robots

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

OS3-1 A new solution to the SLAM problem by using an unscented smoother

Keigo Watanabe[1], Satoshi Funamoto[2], Shoichi Maeyama[1]
([1]Okayama University, Japan)
([2]Shin Nippon Koki Co., Ltd., Japan)

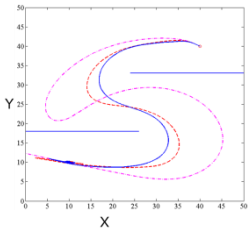
As a solution to the SLAM problem, the extended Kalman filter or unscented Kalman filter (UKF) is often used up to now. In the case of an offline use of estimated results, a fixed-interval smoother is available and it is expected to give much more high accuracy. In this paper, a solution to the SLAM problem is proposed with the unscented Rauch-Tung-Striebel (RTS) smoother (URTSS) and several experimental results are given to show the improvement of the estimation accuracy due to the present method. In particular, the superiority of our method over the conventional UKF based method is demonstrated by evaluating the estimated accuracy of both methods through some simulations using a mobile robot.



OS3-2 Kinodynamic motion planning and control using anisotropic damping forces

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

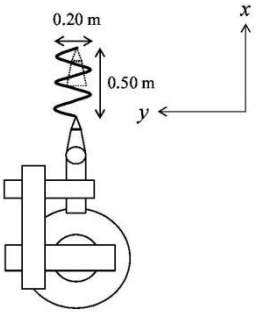
We deal with gain optimization in kinodynamic motion planning by using NADFs (Nonlinear, Anisotropic, Damping Forces) and HPF (Harmonic Potential Field). The NADFs are a kind of controller which has been proposed by Masoud, and it has the effect of canceling the force in unnecessary direction (e.g. any external force or the inertial force). The NADFs have two gains, but optimizing them was not mentioned at all. In this paper, it is assumed that a mass with Kinodynamic Motion Planning is controlled in simulation. The effectiveness of NADFs is verified by comparing the control that uses only the gradient of HPF with the control that introduces the NADFs. At the same time, we apply a method called ``Clamping Control'' to the aforementioned situation, and accomplish a reliable convergence. It is reported through experiments that there exists a possibility of accomplishing more accurate motion planning by optimizing the gains of NADFs.



OS3-3 Application of variable search space GAs to fine gain tuning of model-based robotic servo controller

Akimasa Otsuka, Fusaomi Nagata
(Tokyo University of Science, Yamaguchi, Japan)

In this paper, genetic algorithms with a variable search space function are proposed for fine gain tuning of a resolved acceleration controller which is one of model based robotic servo controllers. Genetic algorithms proposed in this paper have a variable search space function which is activated if the optimal solution is not updated for fixed generations. The function is terminated if the optimal solution is updated, or if the optimal solution is not updated within certain generations. This proposed method is evaluated through a trajectory following control problem in simulation. Simulations for sine curve trajectories are conducted using the dynamic model of PUMA560 manipulator. The result shows the improvement of optimal solution and its convergence.

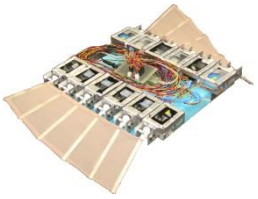


January 30 (Wednesday), 10:00–11:45

OS3-4 Propulsive force analysis of a pectoral fin for rajiform type fish robots from fluid dynamic aspects

Masaaki Ikeda, Shigeki Hikasa, Keigo Watanabe, Isaku Nagai
(Okayama University, Japan)

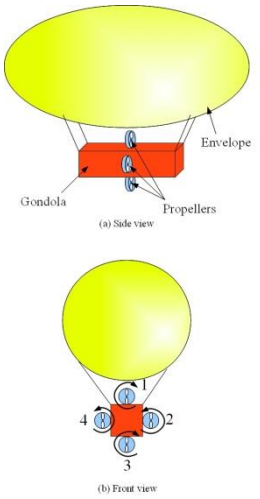
In this paper, we analyze the propulsive force generated from pectoral fins for a rajiform type fish robot from fluid dynamic aspects. A pectoral fin of the rajiform type fish robot is constructed by multiple fin-rays, which move independently, and a film of pushing water. Then, the propulsive force of the fish robot is analyzed from the momentum of the fluid surrounding for every fin between fin-rays. The total propulsive force for one pectoral fin is the sum of these momenta. The propulsion speed of a fish robot is determined from the difference of the propulsive force generated from pectoral fins, and the resistance force that the fish robot receives from the water when moving forward. The effectiveness of the calculated propulsive force is examined through numeric simulation results.



OS3-5 Underactuated control for a blimp with four-propellers by a logical switching method

Yoshikazu Nakamura, Keigo Watanabe, Isaku Nagai
(Okayama University, Japan)

Although most of existing airships employ control methods by combining propellers and rudders, such a control approach has the problem that the maneuverability is deteriorated if their traveling speed is slow. In this research, "X4-Blimp" controlled by only four propellers is proposed. Since the X4-Blimp can control its position and attitude by regulating the output of four propellers, it can realize high maneuverability, irrespective of its traveling speed. However, it is not easy to control the X4-Blimp, because it is an underactuated system. This paper proposes a method for controlling the X4-Blimp by switching two controllers, one of which is constructed by combining models that include nonlinear terms and models that only include linear terms, where those are separated from the derived dynamic model. The effectiveness of the proposed method is verified by some simulations.



OS3-6 Continuous shape-grinding experiment based on model-independent force / position hybrid control method with spline approximation

Akira Yanou, Mamoru Minami, Hiro Tanimoto
(Okayama University, Japan)

Based on the analysis of interaction between manipulator's hand and working object, a model representing the constrained dynamics of robot is first discussed. The constraint forces are expressed by an algebraic function of states, input generalized forces, and constraint condition, and then a decoupling control method of force and position of manipulator's hand tip is proposed. In order to give the grinding system the ability to adapt to any object shape being changed by the grinding, we added estimating function of the constraint condition in real time for the adaptive force / position control, which is indispensable for our method instead of not using force sensor. This paper explores whether the performance of the proposed controller is independent of alloy work-piece models or not. The experimental result is shown in order to verify the feature of the decoupling control of force and position of the tip.

January 30 (Wednesday), 10:00–11:45

Room C

OS4 Complexity and Diversity

Chair: Ken Naitoh (Waseda University, Japan)
Co-Chair: Hiroshi Tanaka (Tokyo Medical and Dental University, Japan)

OS4-1 Catastrophic chaos theory: predicting the edge between health and death

Ken Naitoh, Hirofumi Inoue
(Waseda University, Japan)

Recently, we proposed a macroscopic model for explaining the reason why organs such as a blast cyst, ectodermal endoderm, mesoderm, heart, and hand generate at about sevenfold cell divisions during the morphogenetic process and the bio-chemical standard clock such as circadian one. (Naitoh, AROBJ 2008, 2012, JJAIM 2011) The present standard clock model derived logically with experimental observations is described by a nonlinear differential equation predicting time-evolutions of six macroscopic molecular groups: three gene groups and three enzyme groups, which include acceleration and depression factors. In our previous reports (Naitoh, Proc. JSST, 2011, J. of Physics, 2012), we also find that the fundamental network pattern of neurons will be dominated by the equation. Here, the macroscopic model extended for describing also aging processes shows various types of cycles and reveals the physical condition for determining whether or not living beings such as the human beings can survive after getting ill.

OS4-2 Supercomputing of transition to turbulence in pipe with adit flow

Tsuyoshi Nogami, Takahiro Tobe, Ken Naitoh
(Waseda University, Japan)

Transition from laminar flow to turbulence often occurs in closed pipes such as pathologic blood vessels and artificial systems such as micro-tubes. While varying disturbances entering at pipe inlet or at heart pump, the transition points in space from laminar flow to turbulence in closed pipe are solved by using the weakly-stochastic Navier-Stokes equation and a finite difference method proposed previously by us (Naitoh and Shimiya, 2011), although the previous numerical simulations and instability theories based on the deterministic Navier-Stokes equation could never indicate the transition point in closed tunnel. Here, we qualitatively clarify the relation between the transition point and amount of adit on solid wall, because living systems exchange water and molecules through the wall of blood vessel. A mysterious feature obtained is that a larger amount of additional adit at the inlet may result in laminalization of the boundary layer.

OS4-3 Stock market dynamics derived from a cognitive bias

Moto Kamiura, Yu Murata
(Tokyo Denki University, Japan)

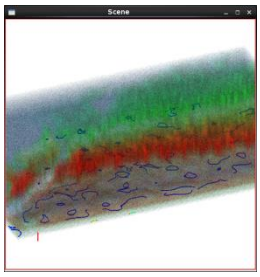
In this study, we present a cognitive experiment which simulates human prediction of stock market returns, which follow an intermediate distribution between a Gaussian and a Cauchy's. Stock market dynamics may be based on not only self-organization of collective traders but also cognitive processes of individuals. This study focuses on the latter: i.e. the ability of individuals generating non-Gaussian distributions. The experiments were done by 144 volunteers, using Windows PCs and application programs for the cognitive experiments. The examinee watches one's monitor displayed a graph of random walk time series, operates one's mouse and input a predicting value on the graph. In the result, we obtained distributions which similar to the ones of stock market returns.

January 30 (Wednesday), 10:00–11:45

OS4-4 Fusion visualization of surface and volume on AVS/Express

Hideo Miyachi[1], Koji Koyamada[2], Naohisa Sakamoto[2]
([1]CYBERNET SYSTEMS CO.,LTD., Japan)
([2]Kyoto University, Japan)

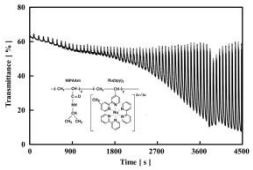
Due to the innovation of super computer technology, the output of simulation by using such high performance computers has complexity and the data size is going to be too large. That makes difficulty to visualize the output for the evaluation and the analysis. To solve the issue, we have started a project sponsored by Japan Science and Technology Agency (JST) in which we develop a new visualization system named "Fusion Visualization" on a commercial software package AVS/Express. It will provide the volume rendering visualization with the surface rendering for conventional visualization methods. In this paper, we will present the plan and some preliminary visualization outputs by using the prototype system.



OS4-5 Autonomous polymer actuators

Yusuke Hara
(The National Institute of Advanced Industrial Science and Technology (AIST), Japan)

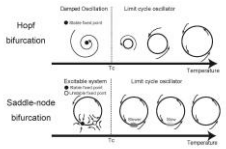
In this paper, in order to design the autonomous polymer actuators for soft robots and microfluidic devices, the effect of the molecular structure of the polymer chain on the self-oscillating behavior and the oscillation period was investigated by utilizing two-types of polymer chains; one is consist of N-isopropyl acrylamid (NIPAAm) and Ru catalyst of the BZ reaction, the other has NIPAAm and Ru catalyst, Acrylamide-2-methylpropanesulfonic acid (AMPS) with anionic charge as a solubility control site. As a result of the measuring the transmittance self-oscillation, it is clarified that the self-oscillating behavior is much affected by the molecular structure of the polymer chain. Moreover, this paper demonstrated the effect of the initial concentration of the three substrates of the Belousov-Zhabotinsky (BZ) reaction on the period of the aggregation-disaggregation self-oscillation.



OS4-6 Cyanobacterial circadian clock is nullified under low temperature via Hopf bifurcation

Yoriko Murayama[1], Hiroshi Kori[2], Takao Kondo[3], Hideo Iwasaki[1], Hiroshi Ito[4]
([1]Waseda University, Japan)
([2]Ochanomizu University, Japan)
([3]Nagoya University, Japan)
([4]Kyushu University, Japan)

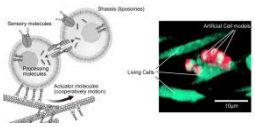
One of the key characteristics of all circadian rhythms is that the free-running period remains stable under a relatively broad range of ambient temperatures, referred to as "temperature compensation" of the period. Outside of the range of temperature compensation, circadian clocks stop running and are arrested at a certain phase. Based on bifurcation theory, Hopf bifurcation and saddle-node bifurcation are plausible scenarios of circadian arrhythmia at low temperature. We focused on a biochemical circadian oscillation, KaiC phosphorylation rhythms, which can be reconstituted in a test tube by mixing the three protines , KaiA, KaiB, and KaiC in the presence of ATP. The KaiC phosphorylation rhythm in vitro is the simplest circadian oscillation to observe directly and precisely dynamics of circadian oscillator. We found that the phenomena of nullification of KaiC phosphorylation rhythm by low temperature was explained by theory of Hopf bifurcation.



January 30 (Wednesday), 10:00–11:45

OS4-7 Molecular robotics for artificial cell-model construction

Shin-ichiro M. Nomura[1], Yusuke Sato[1], Kei Fujiwara[2]
([1]Tohoku University, Japan)
([2]JSPS Research Fellow, Japan)



We have created prototype models of artificial cell with designed functional molecules. Such non-natural molecular devices aimed to have specific properties (sensor, processor, actuator, etc.) which hardly obtained from the natural cells. We call the integrated system of such molecular devices as a "Molecular Robot". In such context, artificial cell research is a goal of the molecular robotics. Here we present the following 'study models'. 1) Gene expressive cell-models of closed lipid bilayer membrane (liposome). 2) Multirole molecular chassis of designed DNA on the cellular membrane. 3) Artificial vesicles equipped with designed sensor peptide for surface recognition. Although these models are inspired from the various living cells phenomenon, such goal-oriented systems are free from the natural history of the earth. These artificial cells might be developed for working side by side with living organisms.

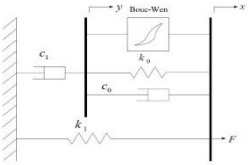
Room D

OS10 Intelligent control and applications

Chair: Kuo-Lan Su (National Yunlin University of Science and Technology, Taiwan)
Co-Chair: Chia-Nan Ko (Nan Kai University of Technology, Taiwan)

OS10-1 Adaptive learning neural networks for system identification of a magneto-rheological damper

Chia-Nan Ko[1], Guan-Yu Liu[1], Yu-Yi Fu[1], Pi-Yun Chen[2]
([1]Nan-Kai University of Technology, Taiwan)
([2]National Chin-Yi University of Technology, Taiwan)



In this article, adaptive learning neural networks (ALNNs) are proposed to identify nonlinear systems. In the proposed NNs, integrating support vector regression (SVR) and adaptive learning algorithm is adopted to optimize the structure of neural networks. In the evolutionary procedure, first, SVR is adopted to determine the number of hidden layer nodes and the initial structure of the NNs. After initialization, adaptive learning algorithm (ALA) with nonlinear time-varying learning rate is then applied to train NNs. In ALA, a computationally efficient optimization method, particle swarm optimization (PSO) method, is adopted to simultaneously find optimal learning rates. Due to the advantages of SVR and adaptive learning algorithm, the proposed NNs (SVR-ALNNs) have good performance for identifying a magneto-rheological (MR) damper system. Simulation results are illustrated the feasibility and superiority of the proposed SVR-ALNNs.

OS10-2 Identification of RBFNs with SVR under censored data

Yu-Yi Fu[1], Yu-Fen Fu[2], Kuo-Lan Su[3], Chia-Nan Ko[1], Jhih-Cheng Chang[1]
([1]Nan Kai University of Technology, Taiwan)
([2]China University of Technology, Taiwan)
([3]National Yunlin University of Science and Technology, Taiwan)

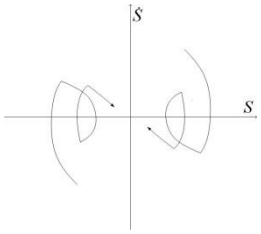
In this paper, we proposed RBFNs with SVR to identify a distribution under censored data. Radial basis function networks (RBFNs) with one hidden layer and rapid convergence speed used to identify system generally. Support vector regression (SVR) with optimal quadratic programming to determine the number of hidden nodes and the initial parameters of kernel and the initial weights of RBFNs. By annealing robust learning algorithm to tune the parameters of kernel and the weights and to overcome the error measurement due to data censored. The simulation result of bivariate normal distribution identification under censored data shows the feasibility of proposed method.

January 30 (Wednesday), 10:00–11:45

OS10-3 Drift algorithm second order sliding mode control for a synchronous reluctance motor

Wen-Bin Lin[1,2], Huann-Keng Chiang[1], Yi-Chang Chang[1]
([1]National Yunlin University of Science and Technology, Taiwan)
([2]Far East University, Taiwan)

This paper shows the design of a drift 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 classical 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 drift algorithm second order sliding mode control. First, the SOSMC is obtained by mathematics. Finally, the presentation of the proposed method is verified by simulation. The proposed SOSMC shows the robustness for the motor parameters variation and the elimination of chattering effect.



OS10-4 Development of the multi-detection system using multi-sensor fusion algorithms

Ying-Yao Ting, Huan-Sheng Wang
(National Kaohsiung First University of Science of Technology, Taiwan)

The paper develops the multi-detection system using multi-level surveillance structure. The system contains active detection modules, passive detection modules, a supervised computer, an image system and an intelligent home. The passive detection modules contain wire/wireless detection modules and appliance control modules, and decide the event to be true or not using fusion algorithms, and transmit detection signals to the supervised computer. Mobile robots are active detection modules and carry various sensors to search dangerous events. Each mobile robot transmits the real-time event signal to the supervised computer and the other mobile robots via wireless RF interface. The image system detects fire source using Otsu algorithm. The system integrates wire/wireless passive detection modules, mobile robots and image system to detect fire source using weighted average method. If the fire event occurrence, the supervised computer calculates the dangerous grade using logical filter method according to the signals of detection modules in the first step, and transmits the position of the fire event to the other mobile robots. The assigned mobile robots move to the event location for double check autonomously, and transmit the detection results to the supervised computer. The supervised computer gives the final decision according to the feedback signals in the second step. Finally, we present some experimental scenarios using active detection …

OS10-5 Design a feasible docking station for mobile robots

Yi-Lin Liao[1], Li-Chun Lai[2], Kuo-Lan Su[1], Jr-Hung Guo[1]
([1]National Yunlin University of Science and Technology, Taiwan)
([2]National Pingtung University of Education, Taiwan)

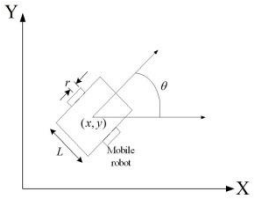
The article develops a docking station that has feasible movement and rotation function for mobile robots. The docking station contains a docking structure, a limit switch, a charger, a power detection module and a wireless RF module. The docking structure is designed with one active degree of freedom and two passive degrees of freedom. It rotates in the Z-axis, and uses compression spring to move for various docking condition. The weight of the docking station is almost 6 kg, and its length, and height, and width are 70cm, 50cm and 80cm. The maximum rotational angle and horizontal offset are 30 degree and 2 cm respectively. The power detection module is controlled by HOLTEK microchip. We calculate the power values using redundant management method, and isolate the error values using statistical signal prediction method, and execute the auto-recharging processing for mobile robots. The processing can enhances the successful rate to guide the mobile robot moving to the feasible docking station from various directions. In the experimental results, the power of the mobile robot is under the threshold value. The mobile robot searches the landmark of the docking station using laser range finder (SICK). The laser range finder guides the mobile robot approach to the docking station, and uses the adequate …

January 30 (Wednesday), 10:00–11:45

OS10-6 A PSO method for time-optimal motion planning of a mobile robot

Li-Chun Lai[1], Kuo-Lan Su[2], Chia-Nan Ko[3], Sheau-Wen Lin[1], Chia-Hung Shih[1]
([1]National Pingtung University of Education, Taiwan)
([2]National Yunlin University of Science and Technology, Taiwan)
([3]Nan Kai University of Technology, Taiwan)

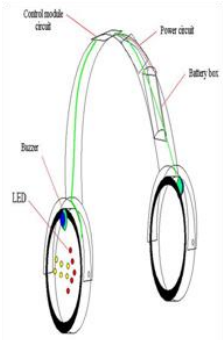
Based on a particle swarm optimization (PSO) algorithm for time-optimal control problem of a two-wheeled mobile robot is addressed in this paper. The PSO algorithm is that it is easier to implement and there are fewer parameters to be adjusted. Different from usual cases, in which the Pontryagin's Minimum Principle (PMP) is used, an iterative procedure is proposed to transform the time-optimal problem into a nonlinear programming (NLP) one. Motion planning of a mobile robot is a NLP problem. In the NLP problem, the count of control steps is fixed initially and the sampling period is treated as a variable in the optimization process. Because the NLP has a initial feasible solutions problem that is not easier to find. In this paper, The PSO algorithm and fitness function to solve initial feasible solutions problem and optimal problem.



OS10-7 The Implementation of Driving anti-sleep Safety warning system

Yi-Yu Lu, Kuo-Kung Chen, Po-Yu Chen, Wen-Bin Lin
(Far East University, Taiwan)

Sometimes a driver deviates from his natural or normal driving style due to inadequate attention or faces abnormal situation caused by a number of psychological and physical factors. Such abnormalities often lead a driver to a mistake that may cause an accident. This paper presents a novel approach called driver-adaptive assist system to avoid such abnormalities in driving scenario as a preventive measure against occurrence of vehicle collisions, assuming that natural driving style of individual drivers is the safest style. This paper presents a driving anti-sleep safety warning system. To prevent from traffic collision due to the driver fall asleep, the proposed system can supervise the driver by LED and buzzer. The system consists of three-axis accelerometer, LED, buzzer, and control circuit. When the system horizontal angle is bigger than setting ones, the system turns on the buzzer to alarm the driver. Finally, a driving anti-sleep safety warning system for vehicle is implemented and to verify the theoretical analysis.



January 30 (Wednesday), 16:00–17:15

Room A

OS9 Information Technology for Environmental Research

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

OS9-1 Study on the efficient use of satellite image data analysis system

Hayao Mori, Seiji Tsukamoto, Takashi Yamaguchi, Masaki Hanada, Jong Geol Park, Eiji Nunohiro
(Tokyo University of Information Sciences, Japan)

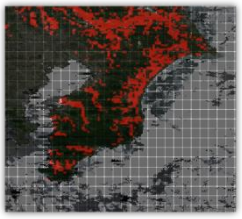
Tokyo University of Information Sciences receives MODIS (Moderate Resolution Imaging Spectroradiometer) data, one of the sensors equipped by NASA's Terra and Aqua satellites, and researches of the analysis on change of environment as part of the academic frontier project. For the information infrastructure of this frontier research, we are developing a satellite image data analysis system to support of web system, a parallel distributed system configuration using multiple PC clusters, database for MODIS data to open the research results and MODIS data for public use. This paper presents the overview of satellite data analysis system and new feature which are the composite of multiple satellite data, and LSM with virtualization of storage system for satellite data, scheduling for multiple cluster nodes and performance evaluation.

January 30 (Wednesday), 16:00–17:15

OS9-2 Administrative division based data segmentation for autonomous paddy field classifier modeling

Takashi Yamaguchi, Shinya Iwasaki, Kazuma Mori, Kenneth J. Mackin, Masaki Hanada, Eiji Nunohiro
(Tokyo University of Information Sciences, Japan)

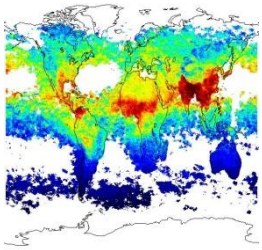
Monitoring changes in paddy area is important since rice is staple food, and paddy agriculture is a major cropping system in Asia. The decision trees or stochastic analysis based methods using spatiotemporal satellite sensor data is effective to monitor paddy area by the remote sensing. On the other hand, it is difficult to apply the same models for different countries and regions. Therefore we applied artificial neural network to classify paddy area in order to automatically generate the classifier. From the computer simulation, the proposed paddy classifier yielded high classification rate in the data subset of north region of Chiba. However, the accuracy was corrupted by the difference of annual cycle pattern. Thus, in this paper, we investigate an administrative division based data segmentation method in order to divide the data set into different groups so that the different patterns of paddy annual cycle is divided to different groups.



OS9-3 Analysis of seasonal variability of methane over global land area

Jonggeol Park[1], Sooyoung Park[1], Youngjoo Kwak[2], Eiji Nunoriho[1], Takashi Yamaguchi[1]
([1]Tokyo University of Information Sciences, Japan)
([2]International Centre for Water Hazard and Risk Management (ICHARM), Japan)

In this study, we determine the global emission concentration of methane using SCIAMACHY data. We analyzed land and sea area to investigate the nine-year changes in methane concentrations from 2003 to 2011. Moreover, by subtracting the concentration of methane from land and sea, we can found the methane emission concentration of land. As a result, it is cleared that a big amount of CH4 emission concentration was found not only in the Northern Hemisphere paddy fields but also in the Southern Hemisphere broad-leaf evergreen areas (Central Africa and South America). And we also found that the global land CH4 growth rate is 3-5ppb/year during 9 years.



OS9-4 Estimating a floodwater from MODIS time series and DEM data using the self-organizing map

Youngjoo Kwak[1], Jonggeol Park[2], Kazuhiko Fukami[1]
([1]International Centre for Water Hazard and Risk Management (ICHARM), Japan)
([2]Tokyo University of Information Sciences, Japan)

Real-time flood mapping with automatic detection technique is increasingly important in emergency response efforts. However, current mapping technology is still limited in accurately expressing information in flood areas such as inundation depth and extent. For this reason, the authors attempt to improve a floodwater detection method with a simple algorithm for a better discrimination capacity to discern flood areas from turbid floodwater, mixed vegetation areas. In this research, pixel classification was performed on the Moderate Resolution Imaging Spectroradiometer (MODIS) time series images for floodwater detection. The purpose of image classification was to estimate a flood area based on the spatial distribution of a nation-wide flood from near real-time MODIS images coupled with a digital elevation model (DEM). Moreover, the authors improved the accuracy of the water extent boundary using a 8-direction tracking algorithm to find the same level between flood-prone area and non-flood area.

January 30 (Wednesday), 16:00–17:15

Room B

GS14 Robotics I

GS14-1 A simple wall-climbing mechanism for a window cleaning robot

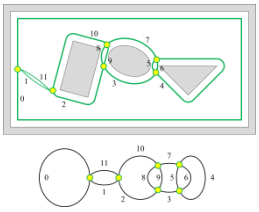
Takafumi Soeda, Nobuhiro Okada, Kazuo Kiguchi
(Kyushu University, Japan)

In this paper, a new type of wall climbing robot to clean window is proposed. The developed robot can climb the pane by using a crawler with ordinary suckers. The suckers of the crawler sequentially stick to the window and the robot climb the pane. The robot will be low-cost and simple. The robot was tested to see whether it have performance to climb the window and to carry cleaning equipments. As the result, it was confirmed that the developed robot can move on the window. This paper gives motivation of this development, concept design of this robot, the details of the system, the experimental result, conclusions and future work.

GS14-2 Topological Graph Based Boundary Coverage Path Planning for a Mobile Robot

Bong Keun Kim, Hideyuki Tanaka, Yasushi Sumi
(Intelligent Systems Research Institute, AIST, Japan)

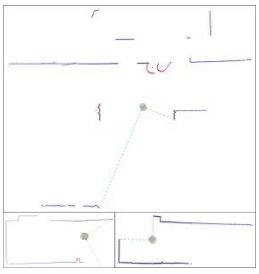
A path planning method for the optimal boundary coverage of building interiors using a mobile robot is proposed. First, the data association problem of indoor modeling caused by localization uncertainties of an information gathering system such as a mobile robot is explained. Then, an expanded obstacle map is proposed to cope with the data association problem, in which the boundaries of the expanded obstacles are utilized as the path of a mobile robot. And also, the path enables a mobile robot to gather information on the obstacles at a certain distance. Next, a topological graph is utilized for the optimization of the travel path. Finally, simulation results are shown to verify the proposed algorithm.



GS14-3 Arc/line segments extraction from unknown indoor environment with laser sensor

Rui-Jun Yan, Jing Wu, Ming-Lei Shao, Ji-Yeong Lee, Chang-Soo Han
(Hanyang University, Korea)

This paper proposed an arc/line extraction algorithm from the unknown indoor environment with a laser sensor. After getting the raw sensor data from laser sensor, the data is divided into different groups by checking the distance of two adjacent points. If the distance is bigger than a limit value, the sensor points in this group will be separated into two groups at these two points. Then the angle of three adjacent points is calculated and compared with another limit value. The group will be split into twos at the middle one of three points if the limiting condition is not satisfied. Moreover, the points in every group are attempted to extracting as a line segment firstly. If the extracted line is not smooth enough, the points in this group are extracted as an arc segment. After the segmenting process, these segments are merged by using the segments merging algorithm. In addition, the experiment results of arc/line extraction in unknown indoor environment by using a HOKUYO laser sensor located on a Pioneer mobile robot are presented.



January 30 (Wednesday), 16:00–17:15

GS14-4 Study on the development of an open motion control platform for a differential mobile robot based on ROS

Jiwu Wang[1], Fangbo Liao[1], Sugisaka Masanori[2]
([1]Beijing Jiaotong University, China)
([2]Alife Robotics Corporation Ltd., Japan)

Robust motion control is prerequisite for an advanced robot. Based on the ROS open source platform, wedeveloped a reliable platform for any differential mobile robot. This platform can be modified according to practical various requirements conveniently. That is, it is an open control platform for any sensors. The developed system has been verified with a mobile robot developed in our lab. The experiment results show its reliability and robustness.

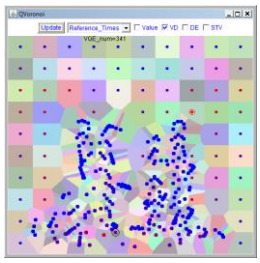
Room C

GS1 Artificial intelligence

GS1-1 A proposition of addition and integration of q-values in Q-Learning

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

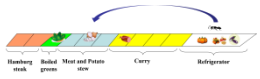
This article presents a method of addition and integration of q-values to reduce the number of states and memory usage based on Q-learning algorithm in continuous state space using the concept of Voronoi space division. It also aims to show the improvement of learning efficiency. We constructed an experimental model to examine these scenarios based on continuous state and discrete action of feeder mouse. As a method of space division, we used Voronoi diagram which is a general space division method. However, Voronoi diagram has a lot of flexibility thus a position determination becomes a problem. Therefore, we presented the addition method in order to realize the position of q-values using LBG algorithm though there are many methods for adaptive vector grouping. In addition, we integrate the q-values which have the same action selections using Delaunay tessellation technique to find the nearest q-values.



GS1-2 Recipe search engine inspired by ant colony's foraging

Jinwook KIM[1], Kazuyuki Ito[1], Katsunori Tachibana[2]
([1]Hosei University, Japan)
([2]NEC Communication Systems, Ltd., Japan)

These days, concern with link between consumer electrical appliances and information devices has been growing such as the refrigerator which has a managing function of food ingredients. This environment is called 'Ubiquitous computing', 'Smart home appliance' which has possibility of further development. In this environment, we consider the system which suggests users some well-balanced recipes that can be cooked by the available ingredients. Especially, we focus on recipe search engine for limited state such as using only existing foods ingredients in the refrigerator. However, conventional keyword search does not suit this system. In this paper, we focus on the ant colony's foraging in order to make a new recipe search engine. We confirm the effectiveness of the proposed search engine by conducting simulations.



January 30 (Wednesday), 16:00–17:15

GS1-3 Phase Scaling Effect of Adiabatic Quantum Computation in Deutsch-Jozsa Problem *(withdrawal)*

Shigeru Nakayama[1], Ichiro Iimura[2], Gang Peng[3]
([1]Kagoshima University, Japan)
([2]Prefectural University of Kumamoto, Japan)
([3]Huizhou University, China)

GS1-4 Constructing Obstacle-Based Triangularized Roadmap

Jeong Hyeon Wang, Ju Jang Lee
(Korea Advanced Institute of Science and Technology, Korea)

This paper proposes an algorithm which makes roadmap quite fast using obstacle information. The proposed algorithm purposes to expand graphs which consist of edge and vertex based on obstacles. After the algorithm detects corner information, using Harris corner detection, keep all data and use it. The proposed algorithm consists of two parts, one is arranging initial nodes using space decomposition, and the other is constructing a graph from initial nodes. In this case, we assume that all the obstacles are polygon. And then we can detect corners of obstacles. Using this, connecting each node to visible corners, we can expand our graph. The proposed algorithm is quite simple and straightforward to understand and it has advantage of constructing fully-covered roadmap. This property has been verified through several experiments.

Room D

OS11 Intelligent control and implement

Chair: Chung-Wen Hung (National Yunlin University of Science and Technology, Taiwan)
Co-Chair: Kuo-Hsien Hsia (Far East University, Taiwan)

OS11-1 Motion planning of the multi-robot based chess game

Yung-Chin Lin[1,2], Yi-Lin Liao[1], Cheng-Yun Chung[1], Kuo-Lan Su[1]
([1]National Yunlin University of Science and Technology, Taiwan)
([2]WuFeng University of Science of Technology, Taiwan)

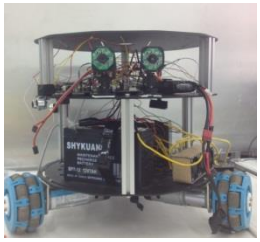
The article develops a docking station that has feasible movement and rotation function for mobile robots. The docking station contains a docking structure, a limit switch, a charger, a power detection module and a wireless RF module. The docking structure is designed with one active degree of freedom and two passive degrees of freedom. It rotates in the Z-axis, and uses compression spring to move for various docking condition. The weight of the docking station is almost 6 kg, and its length, and height, and width are 70cm, 50cm and 80cm. The maximum rotational angle and horizontal offset are 30 degree and 2 cm respectively. The power detection module is controlled by HOLTEK microchip. We calculate the power values using redundant management method, and isolate the error values using statistical signal prediction method, and execute the auto-recharging processing for mobile robots. The processing can enhances the successful rate to guide the mobile robot moving to the feasible docking station from various directions. In the experimental results, the power of the mobile robot is under the threshold value. The mobile robot searches the landmark of the docking station using laser range finder (SICK). The laser range finder guides the mobile robot approach to the docking station, and uses the adequate docking angle to be approach to the station.

January 30 (Wednesday), 16:00–17:15

OS11-2 An Indoor Autonomous Surveillance Robot via Humanoid Vision System

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

This paper is devoted to develop a positioning and tracking scheme for a surveillance robot aiming at suspicious target and measuring the distance to the target. The vision of a general camera is too narrow for tracking fast moving targets. In addition, the flexibility of tracking is limited by robot's dynamics. We design a particular humanoid vision system with two pan-tilt servo systems which can be operated collaboratively or independently. The humanoid vision system is fast and flexible for tracking a moving target and measuring the distance. An embedded system is exploited for the humanoid vision system and robot servo control. An image recognition and tracking algorithm has been developed using LabVIEW for the system. Camshift tracking algorithm can recognize and track suspicious targets efficiently. Different from the previous systems, this system is cheap and easy to control.



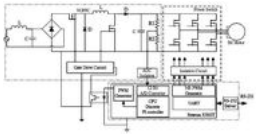
OS11-3 Autonomous robot localization based on 3D pose estimation approach *(withdrawal)*

Chien-Chou Lin, Ben-Zhong Lin, Chang-Hong Wu
(National Yunlin University of Science and Technology, Taiwan)

OS11-4 An ultra-high speed motor driver with hybrid modulations

Chung-Wen Hung
(National Yunlin University of Science and Technology, Taiwan)

An ultra-high speed motor driver with hybrid modulations is proposed in this paper. The speed range of a motor is more wider and trends to ultra-high, but the traditional driver which provides either sinusoidal pulse width modulation or six-step modulation could't support so wide speed range. Normally, the variable voltage variable frequency control is used to support different type motors, then, SPWM is chosen in low speed range drivers and six-step is picked in high speed application. The hybrid modulation driver with adjustable DC bus voltage is proposed, and the modulation could be selected for different motor and speed. For lower switching power loss, the six-step modulation is better when ultra-high speed application. For low speed range, the trapezoidal PWM is used to replace the SPWM for the reduction of switching power loss. The experimental results shows the performance of proposed driver.

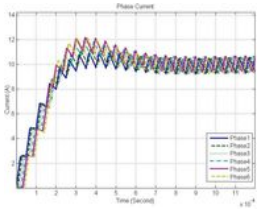


January 30 (Wednesday), 16:00–17:15

OS11-5 A current balance strategy for multi channel interleaved power converters

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

The multi-channel scheme is a more and more popular solution in high power electronic system, due to the current limitation of an inductor, the power switch in every channel, and the reduction of output voltage or current ripple. However, the current unbalance is an issue for the multi-phase scheme, because the current control is independent in high number channel scheme. To solve this issue, a novel current balance control method is introduced in this paper. Compared with the traditional method which needs a current sensor in each channel, the bill of material cost in the proposed method is much lower, because there are only three sensors in the structure: one is used to sense the total current to control the totally current, and the other two sensors are built in the first phase and the last phase for the current balance. The simulation results will be illustrated in this paper to prove this method is workable.



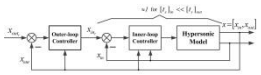
January 31 (Thursday), 10:00–11:00

Room A

GS8 Intelligent control & modeling

GS8-1 Modeling and robust decoupling control for hypersonic scramjet vehicle

Xiaofeng Su, Yuefei Jiang, Yingmin Jia
(Beihang University, China)



In this paper, the modeling and the robust decoupling control for a generic hypersonic scramjet vehicle are studied.
Firstly, the dynamics of the hypersonic vehicle are modeled by applying the Lagrangian approach, which captures the most primary characteristics such as elastic deformation, aerodynamics, aero-heating, variable mass, effect of spherical rotating earth and their inherent interactions. Then, a robust output decoupling controller is designed by using nonlinear dynamic inversion plus the desired proportional integral dynamics, and natural time-scale separation theorem between fast and slow variables. Finally, the nonlinear simulations demonstrate that the controller can eliminate the interaction among the output channels and satisfy the handling quality requirements when the vehicle has parameter uncertainty.

GS8-2 Flocking control of multi-agent systems in a limited space

Sharu Jiang, Yingmin Jia, Shichen Long
(Beihang University, China)

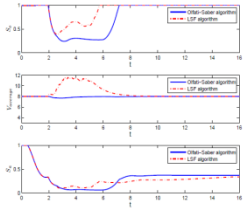
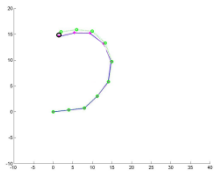


Fig. 2. Contrast figure between two algorithms about $s^{ij}, s^{ij}, V_{average}$

In this paper, flocking control in a limited space is considered. First, a new conception of safety-value is proposed to evaluate the safety between agents and obstacles in a limited space. Then, a new distributed flocking control protocol called the limited space flocking (LSF) algorithm is designed so as to extend the Olfati-Saber's control protocol to the case of a limited space. The algorithm utilizes control protocols corresponding to the safety-value, so the multi-agent system can automatically change its velocity and structure to pass the limited space both quickly and safely. Finally, simulation results show that the proposed algorithm can greatly improve the average velocity of systems and enhance the safety-value in a limited space.

GS8-3 Inverse kinematics in Hyper-redundant robot using Adaptive Neural Network

Chatklaw Jareanpon
(Polar lab, Department of Computer Science, Faculty of Informatics, Mahasarakham University, Thailand)

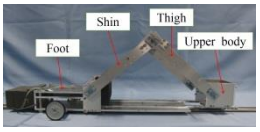


The hyper-redundant robot has more degrees-of-freedom. The most difficulty of the hyper-redundant is to finding the inverse kinematic problem. Most of usually used method is Neural Network. However, it is difficult to find the suitable structure and number of node. This paper shows the novel algorithm that can find the suitable structure and number of node depends on the problem. The performance of this algorithm will demonstrated in the computer simulation and compare with the Back-propagation with same structure. The algorithm shows the good performance to adapt the number of node with less error to solve the 8-20 serial link chain hyper-redundant robots.

January 31 (Thursday), 10:00–11:00

GS8-4 Reduction of Impact when a Humanoid Robot Lands on the Ground

Homare Fujieda, Shingo Okamoto, Jae Hoon Lee
(Ehime University, Japan)



The purpose of this research is to reduce the impact force when robot land on the floor by landing motion. First, landing postures of a human were analyzed measuring impacts when the human land on the floor. Through the experimental result on relations between landing postures and the impact forces, it was hypothesized that a human may reduce the impact force by motion control of gravity center of the human, for example to lengthen the time in landing motion. Then a landing robot was developed and the experiment to measure the impact forces was conducted, in order to prove the hypothesis.

Room B

GS15 Robotics II

GS15-1 Study on the remote and high accurate measurement of micro-cracks on the bottom of a bridge

Jiwu Wang[1], Shaodong Do[1], Fangbo Liao[1], Masanori Sugisaka[2]
([1]Beijing Jiaotong University, China)
([2]ALife Robotics Co., Ltd., Japan)

Cracks are significant signs to internal defects in a bridge. It is important to detect initial micro-cracks for the bridge maintenance and conservation. Now the bridge micro-cracks can only be measured at a short range. It is nearly impossible to measure the micro-cracks by this way only with simple devices. In this paper, based on the laser triangulation principle, a measurement system is developed to measure dimensions of a remote object with machine vision. Based on this technique, the micro-carcks' dimensions can be measured efficiently. In our lab, its accuracy and reliability is verified by measuring various objects. The experiments show the system runs robust under multiple working conditions. Most of all, the micro-cracks with the width of 0.2mm can be measured accurately when they are approximately 4 meters away.

GS15-2 The small eye and tongue module for an android robot head

Dongwoon Choi, Dongwook Lee, Duckyeon Lee, Byeong-kyu Ahn, Hogil Lee
(Korea Institute of Industrial Technology, Korea)

In this paper, the small size eye and tongue module for an android robot head are presented. There are narrow spaces inside the android robot head by its human like shape and size, so to use small size parts is very important to design an android robot head. We tried to design an android robot head with 32 D.O.F and human like shape, but as the large numbers of D.O.F and human like shape, it was needed to make small size of each module to achieve our goal. The eye module presented has 2 D.O.F for eyeball and 1 D.O.F for eyelid, so there are roll, pitch motion for eyeball and pitch motion for eyelid like human eye. A universal joint structure was generally used in robot eye, but a spherical joint was selected to reduce space occupying by its simple structure. The spherical joint is very simple and small, but it has 3 D.O.F even if there are only 2 constraints in eye, so rotation motion of eye can be occurred. To avoid rotation of eyeball by using spherical joint, spring column was installed in center of eyeball. There has been no active tongue for an android robot or humanoid robot until now. The tongue is very important factor to design human like robot because it can be shown when the robot speaks, so an active tongue give more reality to an android robot when it speaks. Additionally, there are many emotional expressions to use tongue like ridicule, so tongue can help to make more various emotional expressions in android robot research. The tongue module has a flexible silicon complex skin for natural motion and human like looks. It has 2 D.O.F for put-in, put-out and bending.
…

January 31 (Thursday), 10:00–11:00

GS15-3 Design of a robotic arm's behavior in imitation of animal consciousness: development of altruistic behavior

Kyoko Tanaka, Eiji Hayashi
(Kyushu Institute of Technology, Japan)

Our research has been focused on developing a robot with a "consciousness" like that of 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 related software architecture, called Consciousness-based Architecture (CBA), by which this model can be used to control the action of an artificial animal. Here, 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 how a robot determines what action to take. Our motivation model is based on the dopamine-generating mechanism of sentient beings. In the present study, we focus on the altruistic behavior of animals so that the consciousness and behavior of the robot approximate those of an animal. We added altruistic behavior to the CBA and tried to construct a system in which the robot cooperates with the user and chooses altruistic behavior.

GS15-4 Network Based Multiple Mobile Robots with Subsumption Architecture Supporting Swarm Behaviors

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

This paper presents the use of dynamic sampling period to evaluate the basic behavior performance of network-based multiple mobile robots system with cooperative swarm behaviors. Network-based subsumption architecture with PC server is proposed to minimize the total cost for designing and multiple mobile robots system by maximizing the group performance of robots with limited hardware and software capabilities rather than optimizing the behavior performance of a individual robot. This enables to develop high-level group behavior architecture such as a complex schooling behavior. Such capability is based on decomposing a complex behavior into simple and basic behaviors that are organized into layers of subsumption architecture. Finally, this paper, the basic performance of the network- based subsumption architecture is experimentally evaluated in association with the measurement of the dynamic sampling period.

January 31 (Thursday), 10:00–11:00

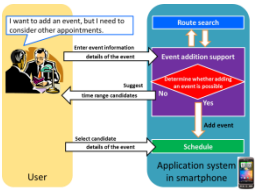
Room C

GS5 Human-machine cooperative systems

GS5-1 Design of a user support system for event addition based on route search using schedule information

Hiroki Imamura, Hiroyuki Nishiyama
(Tokyo University of Science, Japan)

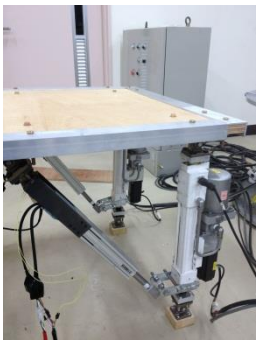
In recent years, the ability to manage schedules using a mobile device equipped with a touch panel has increased. However, when one wishes to add a new event to the schedule book, taking into account the transit time of an existing event, it is necessary to switch to another application or website. In this paper, we design a system for additional support events to automatically determine whether the new event can be added. If this is impossible, the system proposes a time range that can have events added.



GS5-2 The study of walking control with plural cylinder leg robots

Jihao Cao, Feifei Zhang, Masanori Ito, Takumi Yaginuma
(Tokyo University of Marine Science and Technology, Japan)

Now, there exist very urgent request that robot should be applied, instead of human being to the work at the Fukusima atomic energy generating station which has the high nuclear level and complicated terrain. However, the current technology of crawler-type or wheel-type robots cannot fully work in such condition. Our goal of this research is to develop a working robot which has a human level power and walks with form four legs. In our experiment, we constructed, each leg with two cylinders. So, the robot can keep the motion under heavy load. The four legs will move in order that the robot can walk forward and backward. We are studying the control scheme of walking for this robot, which is putting mind especially on smooth and steady movement without rolling, pitching, yawing or heaving motion and keeping the body horizontally. We confirmed the validity of control scheme with experiments.



GS5-3 The Ground Reaction Force generation algorithm for tracking the wearer's

Sukwoo Lee[1], Jongwon Lee[1], Hyogon Kim[2], Jaeho Jang[2] and Sangdeok Park[2]
([1]University of Science and Technology, Korea)
([2]Korea Institute of Industrial Technology, Korea)

This paper explains the desired ground reaction force (GRF) generation algorithm for exoskeleton. Its key point is to generate the desired torque of exoskeleton for tracking the wearer's motion. We can obtain the torque by using the GRF when exoskeleton foot is in contact with the ground. It is not necessary to measure exerted force at contact point. It requires only simple calculation in contrast with inverse dynamics of full body. It can adapt to environment such as flat ground, stairs and uneven surfaces. We present simulation result using our two-leg model, which demonstrates the algorithm is applicable to exoskeleton.

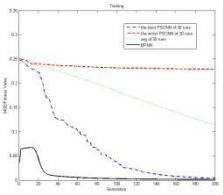
January 31 (Thursday), 10:00–11:00

Room D

GS12 Neural networks

GS12-1 Epilepsy Diagnosis Using PSO based ANN

Nesibe Yalçın[1], Cihan Karakuzu[1], Gülay Tezel[2]
([1]Bilecik Şeyh Edebali University, Turkey)
([2]Selçuk University, Turkey)



Electroencephalogram (EEG) is used routinely for diagnosis of diseases occurring in the brain. It is a very useful clinical tool in classification of epileptic attacks and epilepsy diagnosis. In this paper, epilepsy diagnosis by evaluation of EEG records is presented. Artificial Neural Networks (ANN) is used as a classification technique. Particle Swarm Optimization (PSO) method, which doesn't require gradient calculation, derivative information and any solution of differential equations is preferred for ANN training. This training method is compared with back propagation algorithm, which is one of the traditional methods, and the results are interpreted. In case of using the PSO algorithm, the training and test classification accuracies are %99.67 and %100, respectively. PSO based neural network model (PSONN) has a better classification accuracy than back-propagation neural network model (BPNN) for epilepsy diagnosis.

GS12-2 The effect of the internal parameters on association performance of a chaotic neural network

Shun Watanabe[1], Takashi Kuremoto[1], Kunikazu Kobayashi[2], Masanao Obayashi[1]
([1]Yamaguchi University, Japan)
([2]Aichi Prefectural University, Japan)

The chaotic neural network (CNN) proposed by Aihara et al. is able recollect stored patterns dynamically. But there are difficult cases such as a long time processing of association, and difficult to recall a specific stored pattern during the dynamical associations. We have proposed to find the optimal parameters using meta-heuristics methods to improve association performance, for example, the shorter recalling time and higher recollection rates of stored patterns in our previous works. However, the relationship between the different values of parameters of chaotic neurons and the association performance of CNN was not investigated clearly. In this paper, we analyze how the change of values of internal parameters of chaotic neurons affects the characteristics of chaotic neurons when multiple patterns are stored in a CNN. Q-Q plot, least square approximation (LSM), hierarchical clustering (HC), and Hilbert transform (HT) are used to investigate the similarity of internal states of chaotic neurons, and to classify the neurons. Simulation results showed that the different values of the internal parameter yielded different behaviors of chaotic neurons and it suggests the optimal parameter …

GS12-3 An estimating method for missing values by using multiple SOMs

Yuui Kikuchi, Nobuhiro Okada, Yasutaka Tsuji, Kazuo Kiguchi
(Kyushu University, Japan)

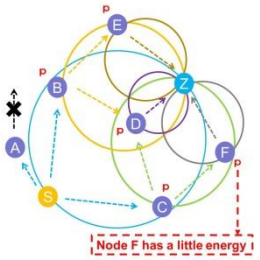
Recently, development of information technology grows the importance of data analysis. In actual data, however, instances will sometimes miss some of their values. Then, how to deal such missing values has become one of the important subjects. Estimating and completing the missing values is required when analyzing the instances or attributes including the values. Using a self-organizing map (SOM) is one of such estimating method. This method is available for nonlinear data. In the data which lacks instances which are not including missing values, however, it was difficult to estimate such values by using conventional SOM method. To solve the problem, we propose a new method that uses multiple SOMs for estimating missing values. To evaluate our method, we performed simulation using proposed and other conventional methods. By the simulation results, we showed the advantages of our method.

January 31 (Thursday), 10:00–11:00

GS12-4 Proposal and Evaluation of information gathering methods that considers the MANET's load in a desaster

Keisuke Gohara, Hiroyuki Nishiyama
(Tokyo University of Science, Japan)

When a disaster occurs, victims must be rescued quickly and their safety confirmed. However, current informationgathering systems may become unusable if their infrastructures are destroyed. The Mobile Ad Hoc Network (MANET) is a rescue-support system. MANET typically uses the flooding strategy. In flooding, the source node broadcasts the Route Request Control Packet (RREQ) to discover a route to the destination. However, this generates a high number of redundant retransmissions, so flooding places a huge burden on the devices that compose MANET. In this paper, we propose a MANET system that uses location information and the current energy status of the node. By simulating a disaster, we demonstrate that our proposed system outperforms the existing systems in terms of the total number of RREQs and the average power consumption.



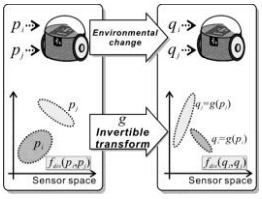
January 31 (Thursday), 11:15–12:15

Poster Session

PS1-1 Application of the actor-critic method to a robot using state representation based on distance between distributions

Manabu Gouko
(Tohoku Gakuin University, Japan)

In a previous study, I provided a state representation based on noisy sensor data using distances between probability distributions. The proposed state representation is not influenced by environmental changes.
In the previous study, I applied reinforcement learning to the autonomous mobile robot using the proposed state representation. In the study, Q-learning method was used to train the robot, and I showed that the robot can learn an appropriate state–action relationship to perform the task. However, Q-learning cannot usually be applied to discrete state and action spaces.
In this study, I applied an actor-critic method to a mobile robot, which uses the proposed state representation. Actor-critic method is one of the algorithms of reinforcement learning that can deal with a continuous state and action space. I performed a simulation and verified that the mobile robot can learn action relationship in the suite state using the actor-critic method.



PS1-2 Color Halftoning Using the Error Diffusion Method by the Edge Adjustment and the False Colored Limit

Kazuya Kadoya, Ken-ichi Tanaka
(Meiji University, Japan)

In the device that the usable number of the colors and density of printer or facsimile communication are limited, the digital halftoning is an important technique. When you use error diffusion method for mix of color and monochrome images, false color appear in monochrome parts. The images were evaluated using the Mean Squere Error. The image evaluation of MSE had rise. And so the evaluation with the monitor, a very good value was in this way provided. Full-color images grayscale is not contaminated and black and white images, images of the experimental results of different patterns, without compromising the quality of the original error diffusion method, we solve the problem.

January 31 (Thursday), 11:15–12:15

PS1-3 The Three Optimization Methods of Searching The Effective Combination Dither Matrix

Shohei Niinuma, Kenichi Tanaka
(Meiji University, Japan)

In this paper, we proposed the dither matrix for color image with optimization methods. A dither method displays a grayscale picture that is expressed two colors. They are black and white values. Thereby, in a picture, although it is two values, in view of a distant view, it seems that there is a monochrome shade. I used three methods that are Genetic Algorithm (GA), Simulated Annealing (SA), and taboo searching (TS). The criterion of comparing data is cost E that is the evaluation value of reproduction of gray image. And it is addition of evaluated value of gray level and evaluated value of contrast.

PS1-4 Inverse halftoning of color image using unsharp mask

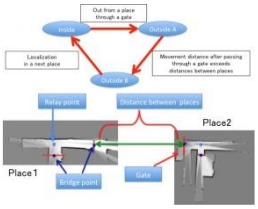
Hiroki Matsuo, Ken-ichi Tanaka
(Meiji University, Japan)

The inverse halftoning is image restoration technique to make the grayscale image from binary image that is processed by digital halftoning. Inverse halftoning techniques need the removal of the noise. This is because the noise is added to reconstruct the pseudo grayscale image using black and white. In inverse halftoning image, important information also blurred when the noise in inverse halftoning image is reduced. In other hand, when the edge in inverse halftoning image is left, reducing the noise becomes insufficient. The goal of the inverse halftoning technique that can reduce the noise on inverse halftone image and that can emphasize the edge on inverse halftoning image. Therefore we propose inverse halftoning to emphasize the edge using unsharp mask. As a result of using unsharp mask, SNR became higher than conventional method and became easy to look visually.

PS1-5 Development of mobile robot navigation system using simplified map based on place recognition

Satoshi Yamanaka, Kazuyuki Morioka
(Meiji University, Japan)

This paper introduces a mobile robot navigation system using simplified hybrid maps based on occupancy grid maps of important places and relationships among them. In order to achieve autonomous navigation with the hybrid maps, additional information, such as waypoints in important places with occupancy grid maps, are learned in SLAM process. Also, navigation system based on state transition between inside and outside of the important places is proposed. Finally, experimental results with actual robot systems in indoor environments are shown.



January 31 (Thursday), 11:15–12:15

PS1-6 Robots from printer: the prospect of using printed electronics technologies for producing robots and creating objects of electronic artificial life

Sergey N. Orlov, Evgeny S. Gornev, Nikolay A. Zaytsev, Sergey I. Yanovich
Andrey G. Krasnikov, Ilya A. Khomyakov
(Molecular Electronics Research Institute JSC, Russia)

Printed electronics is a promising direction of microelectronics technology development and represents the set of printing methods used for electronic devices creation. In the printed electronics the formation of electronic scheme structure is carried out like printing the text on paper. Technologies of printed electronics allow you to create cheap, flexible, lightweight, disposable and reusable electronic devices. Today the printed electronics technologies have reached that level when an opportunity is opening for printer press of the miniature robots, such as beautiful butterflies. Virtually all of the components for miniature machines can be printed, cut, folded and put into motion. The films of electro-actuated polymers can be used as artificial muscles of miniature robots. There are many polymers that are suitable for this role. Japanese corporation Eamex in partnership with Daiichi Kogei developed a robotic fish what swim with help of artificial muscles (Yomiuri Shimbun, December 12, 2002). Researchers from the University of California at Berkeley are developing technology to produce miniature robots that are assembled from individual units, printed on a printer [1]. Paul Birkmeyer and Ronald Fearing at UC Berkeley created the power autonomous hexapedal robot, moving like a cockroach [2]. Structure weighs just over 16 grams, has a length of about 10 cm and moves at a speed of 1.5 m/sec. The robot is built from laminated cardboard except for the control of the microcontroller and the motor. All its parts are cut on a special machine from a cardboard sheet and then gather together.

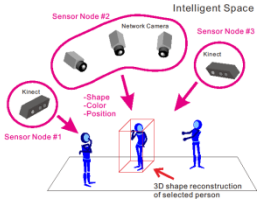
PS1-7 Teaching method for the industrial dual-arm robot

Taeyong Choi
(KIMM, Korea)

The dual-arm robot for manufacturing is a new trend in the industrial robot. Dual-arm industrial robot is suitable for assembly process owing to its arm and body configuration similar to human. In our project, application target process is IT product assembly line such as cellular phone, TV and etc. A new teaching method to make robot do complex motion is also required. Coventional teaching method is not proper for complex process. It is based on PTP teaching not task teaching. We propose a new teaching method, that is a task based hybrid teaching method. User can choose multiple teaching method among several teaching method in our concept. However, only three distinctive teaching method provided in our study. User can configure the robot motion and trajectory using all provided teaching method.

PS1-8 Real-time 3D-Shape Reconstruction System in Intelligent Space Based on Networked Vision Sensors

Takashi Ishimaru, Kazuyuki Morioka
(Meiji University, Japan)



In recent years, intelligent spaces based multi-viewpoint cameras and range image sensors have been developed. Especially, real-time human 3D shape reconstruction system with multiple sensors in intelligent space is considered in this study. In order to achieve application of human shape reconstruction in intelligent space, it is necessary to integrate several kinds of sensors efficiently. This paper focuses on roles and functions required to each sensor node, and proposes systematic structures with RT-component for sensor integration.

January 31 (Thursday), 11:15–12:15

PS1-9 Using a GA-based extension recognized method for fault diagnosis in car engines

Meng-Hui Wang, Pi-Yun Chen
(National Chinyi University of Technology, Taiwan)

Due to the passenger's security, the recognized hidden faults in car engines are the most important work for a maintain engineer, so they can regulate the engines to be safety and improve the reliability of automobile systems. In this paper, we will present a novel fault recognized method based on the genetic algorithm (GA) and the extension theory, and also applies this method in the fault recognition of a practical car engine. The proposed recognized method has been tested on the practical tested records of the Nissan CEFIRO 2.0 engine and also compared with other traditional classified methods. Experimental results are of great effective for the hidden faulting recognition of car engine, the proposed method also suits application in other industrial apparatus.

PS1-10 Design of a rehabilitation robot suit with hardware-based safety devices: Proposal of the basic structure

Yoshihiro Kai[1], Satoshi Kitaguchi[1], Wenlong Zhang[2], Masayoshi Tomizuka[2]
([1]Tokai University, Japan)
([2]University of California, Berkeley, USA)

Safety is one of the most important issues in rehabilitation robot suits. We present a new rehabilitation robot suit equipped with two hardware-based safety devices. The robot suit assists a patient's knee joint. The safety devices consist of only mechanical components without actuators, controllers, or batteries. We expect that the safety devices guarantee the safety even if the computer does not work. We call one device the "velocity-based safety device" and the other device the "torque-based safety device". The velocity-based safety device can switch off the motor of the robot suit if the device detects an unexpected joint angular velocity. Also, the torque-based safety device can switch off the motor if the device detects an unexpected joint torque.

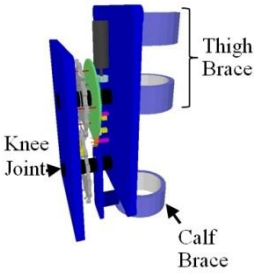


Fig. Rehabilitation robot suit with hardware-based safety devices

PS1-11 Through-Wall Imaging for a Metallic Cylinder by Dynamic Differential Evolution

Chung-Hsin Huang[1], Chi-Hsien Sun[2], Ping-Chieh Chiang[2], Lung-Fai Tuen[3], Ching-Lieh Li[3], Pin-Ru Lai[3]
([1]Taipei College of Maritime Technology, Taiwan)
([2]National Taiwan University of Science and Technology, Taiwan)
([3]Tamkang University, Taiwan)

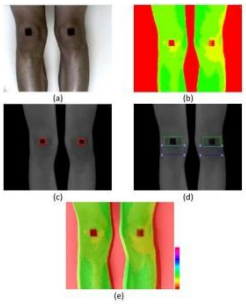
Through wall imaging for estimating shape of a metallic cylinder is proposed. The ability of dynamic differential evolution (DDE) stochastic searching algorithm for shape reconstruction of 2-D conducting targets hidden behind a homogeneous building wall is demonstrated by using simulated backscattered fields. After an integral formulation, a discretization using the method of moment (MoM) is applied. The through-wall imaging (TWI) problem is recast as a nonlinear optimization problem with an objective function defined by the norm of a difference between the measured and calculated scattered electric field. Thus, the shape of metallic cylinder can be obtained by minimizing the objective function. Simulations show that DDE can successfully reconstruct the through-wall imaging for a metallic cylinder.

January 31 (Thursday), 11:15–12:15

PS1-12 Analysis of Effects of Exercises on Middle-aged and Elderly Arthritics by Thermal Imagery and Automatic Auxiliary Diagnosis

Chin-Lun Lai[1], Tsung-Ching Lin[2], Tung-Lin Yang[1]
([1]Oriental Institute of Technology, Taiwan)
([2]Far Eastern Memorial Hospital, Taiwan)

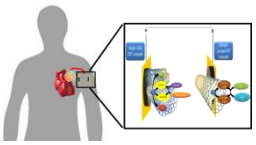
In this paper, an automatic infrared thermal image analysis method is proposed to analyze the rehabilitation effects, after simple exercise intervention, on middle-aged and elderly osteoarthritic patients, while an automatic CV diagnosis criteria for distinguishing the patients from the healthy persons is also established, to assist medical personnel's diagnoses and suggestions. To approach this goal, the questionnaires from the Western Ontario and McMaster Universities are also used as basis for evaluating physiological changes before and after rehabilitative exercises and the data analyzed may also be used as the reference for subsequent exercise adjustment by the subject. Experimental results shows that the proposed method performs well in automatic judgement of degenerative arthritis hence can be a good reference for clinical diagnosis.



PS1-13 Enhancing electrical communication through reconstructed nanowire electrodes for implantable enzymatic biofuel cell (EBFC)

Deby Fapyane[1], Soo-Jin lee[1], DuHyun Lim[2], Jou-Hyeon Ahn[2], In seop Chang[1]
([1]Gwangju Institute of Science and Technology (GIST), Korea)
([2]Gyeongsang National University, Korea)

Enzymatic biofuel cell (EBFC) is a promising continuous energy supply powered by abundant and essential components in human physiological fluid; glucose and oxygen, for powering implanted device. Important aspects in BFC are establishing efficient electron transfer pathways between enzyme redox center and electrodes and maintaining enzyme stability. In this study we characterized of electron transport from enzyme as core of BFC to the nanowire by edge-immobilization (EI) and sidewall-immobilization (SI). Through immobilization in both aspects of nanowire surface, electrical transport through edge is responsible for efficiency meanwhile sidewall immobilization benefits for enzyme stacking compartment. We also studied the functional group exist in nanowire may act as bridge to individual nanowire. Nanowire which is lacking of EWG diminished electron transport enhancement between C-C bonds through resistance barrier. Further study which factor limiting and enhancing electrical transport through pristine and constructed carbon nanotube is still being assessed.



PS1-14 Object tracking based on adaboost classifier and particle filter

Chin-Lun Lai, Li-Yin Lee
(Oriental Institute of Technology, Taiwan)

In this paper, a hybrid structure combining adaboost classifier and particle filter is proposed to automatically detect and track the pedestrian targets. The adaboost detection process is adopted first to target candidate objects, and then the particle filter is applied for confirming and tracking of targets. Experiment results show that via the proposed method, the drawback of the current particle filters which requires specifying an object to be tracked in advance can be overcome, while performing good also in cases of target missing, occlusion, and identifying the previously appeared objects.

January 31 (Thursday), 11:15–12:15

PS1-15 A metaheuristic for huge scale quadratic assignment problems

Hatsumi Nakaura, Fubito Toyama, Hiroshi Mori, Kenji Shoji, Juichi Miyamichi
(Utsunomiya University, Japan)

The quadratic assignment problem (QAP) is one of the most difficult problems in the NP-hard class. Many metaheuristics have been proposed for the QAP. To evaluate the performance of these algorithms, QAPLIB which is a library of QAP instances is used. But QAPLIB does not have large scale QAP instances. QAPLIB cannot be used to evaluate the performance for large scale instances. Thus, these metaheuristics have been only applied to small scale QAP instances. It is difficult to apply these algorithms to large scale QAP instances because the number of combinations is huge. In this paper, we propose a metaheuristic approach for large scale QAP. The computational results showed that the proposed method outperformed conventional methods for huge scale QAP instances.

PS1-16 Competition-based Particle Swarm Optimizer for solving Numerical Optimization Problems.

Sheng-Ta Hsieh, Bo-Han Chen
(Oriental Institute of Technology, Taiwan)

In this paper, a new variant of particle swarm optimizer is proposed for solving numerical optimization problems. The main difference between proposed method and common PSO is the swarm structure. In general, the PSO has only one swam and each particle of the swarm will share their information for guiding other particles toward to potential solution space. The proposed method is to separate swarm into two sub-swarm. The size of two sub-swarms will be adjusted according to their performance. It can drive increased the diversity of the particles and prevent particle to fall into the local optimum. For testing the performance of proposed method, fifteen of CEC 2005 test functions were selected for experiments. From the result, it can be observed that the proposed method performs better than SPSO2011.

PS1-17 Elitist Differential Evolution for solving Numerical Optimization Problems

Sheng-Ta Hsieh, Huang-Lyu Wu, Tse Su
(Oriental Institute of Technology, Taiwan)

In this paper, an elitist strategy is proposed for enhancing solution searching performance of Differential Evolution (DE). Also, a new variant of mutation for DE is proposed to improved population's exploration and prevent particles form fall into local optimum. In the experiments, 10 hybrid composition functions of CEC 2005 test functions are selected for testing performance of proposed method and compare it with 4 DE variants. From the results, it can be observed that the proposed method exhibits better than related works.

PS1-18 Artificial Bee Colony Algorithm with Crossover Strategy for Global Numerical Optimization

Sheng-Ta Hsieh, Jhih-Sian Chen
(Oriental Institute of Technology, Taiwan)

In this paper, a new variant of artificial bee colony (ABC) algorithm is proposed for solving numerical optimization problems. In order to increase population's solution searching ability, the crossover operation of genetic algorithm (GA) is involved to produce new potential offspring. In the experiment, the CEC 2005 test functions are adopted for test proposed method and compared it to related works. From the results, it can be observed that the proposed method performed better performance than two variants of ABC approaches.

January 31 (Thursday), 11:15–12:15

PS1-19 Microwave Imaging of Dielectric Cylindrical Target Using Dynamic Differential Evolution and Self-Adaptive Dynamic Differential Evolution

Ching-Lieh Li[1], Chi-Hsien Sun[2], Chung-Hsin Huang[3], Lung-Fai Tuen[1], Huang-Wei Wong[1]
([1]Tamkang University, Taiwan)
([2]National Taiwan University of Science and Technology, Taiwan)
([3]Taipei College of Maritime Technology, Taiwan)

The inverse problem under consideration is to reconstruct the characteristic of scatterer from the scattering E field. Dynamic differential evolution (DDE) and self-adaptive dynamic differential evolution (SADDE) are stochastic-type optimization approach that aims to minimize a cost function between measurements and computer-simulated data. These algorithms are capable of retrieving the location, shape and permittivity of the dielectric cylinder in a slab medium made of lossless materials. The finite-difference time-domain (FDTD) is employed for the analysis of the forward scattering. Numerical results indicate that both optimization methods are reliable tools for inverse scattering applications. In the particular case of small-scale problems investigated in this paper, SADDE outperforms the DDE a little in terms of reconstruction accuracy.

PS1-20 Application of Natural Language Processing for Information Retrieval

Su Mei Xi[1], Dae Jong Lee[2], Young Im Cho[3]
([1]TShandong Polytechnic University, China)
([2]Chungbuk National University, Korea)
([3]Suwon University, Korea)

Through a comprehensive analysis of using natural language processing in information retrieval, we compared the effects with the various natural language techniques for information retrieval precision in this paper. This is for the tasks of more suitable as well as accurate results of natural language processing.

January 31 (Thursday), 14:30–15:30

Room A

GS4 Control techniques

GS4-1 Self-triggered optimal control based on optimization with prediction horizon one

Koichi Kobayashi, Kunihiko Hiraishi
(Japan Advanced Institute of Science and Technology, Japan)

Self-triggered control is a control method that the control input and the sampling period are computed simultaneously in sampled-data control systems, and is extensively studied in the field of networked control systems. In this paper, a new approach for self-triggered control is proposed based on model predictive control. First, the optimal control problem with horizon one, in which the first sampling period and the control input are found, is formulated. By solving this problem at each sampling interval, self-triggered model predictive control is realized. Next, an iterative solution method is proposed. In this solution method, a quadratic programming problem is repeatedly solved. Finally, the effectiveness of the proposed approach is shown by a numerical example.

January 31 (Thursday), 14:30–15:30

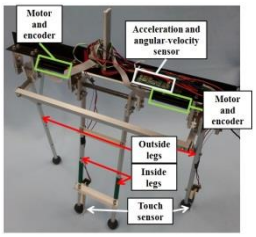
GS4-2 H∞ controller with graphical LMI region profile for gantry crane system

Mohd Zaidi Bin Mohd Tumari, Muhammad Salihin Bin Saealal
Mohd Riduwan Bin Ghazali, Yasmin Binti Abdul Wahab
(Universiti Malaysia Pahang, Malaysia)

This paper presents investigations into the development of H∞ controller with pole clustering based on LMI techniques to control the payload positioning of INTECO 3D crane system with very minimal swing. The linear model of INTECO 3D crane system is obtained using the system identification process. Using LMI approach, the regional pole placement known as LMI region combined with design objective in H∞ controller guarantee a fast input tracking capability, precise payload positioning and very minimal sway motion. A graphical profile of the transient response of crane system with respect to pole placement is very useful in giving more flexibility to the researcher in choosing a specific LMI region. The results of the response with the controllers are presented in time domains. The performances of control schemes are examined in terms of level of input tracking capability, sway angle reduction and time response specification. Finally, the control techniques is discussed and presented.

GS4-3 Optimized Walking Control of a Biped Walking Robot Considering Theory of a Pendulum

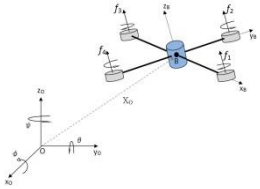
Hisashi Koike, Jae Hoon Lee, Shingo Okamoto
(Ehime University, Japan)



A motion control based on the theory of passive walking has been investigated in this paper. It has been known that general passive walking robot can walk efficiently on the slope by using potential energy with no actuator. However, it cannot walk on the horizontal ground. In order to utilize the merit of energy efficiency, two motors were installed at the hip joints of the passive-walking-type robot, which generate required torque for walking on the horizontal ground. The proportional control algorithm was applied for successive walking. Computer simulations with its dynamic model were carried out to find out the optimal condition for walking motion. Based on the simulation results, experimental robot was developed. As a result, the capability of walking on the horizontal ground was confirmed through experimental works with the proposed method and the developed robot.

GS4-4 Sliding mode control of a quad rotor helicopter using nonlinear sliding surface

Bambang Sumantri[1,2], Naoki Uchiyama[1], Shigenori Sano[1], Yuma Kawabata[1]
([1]Toyohashi University of Technology, Japan)
([2]Electronic Engineering Polytechnic Institute of Surabaya, Indonesia)



In this paper, a sliding mode controller (SMC) based on a nonlinear sliding surface (NSS) is designed for controlling a quad rotor helicopter (quadrocopter). It is a well-known that a low overshoot can be achieved with a cost of longer settling time, although a shorter settling time is needed for quick response in a quadrocopter system. In the conventional SMC, the sliding surface is designed as a linear surface that provides a constant damping ratio. The value of damping ratio should be adjusted in order to obtain an optimal performance by making a tradeoff between the two criteria; overshoot and settling time. In this paper, an NSS is designed so that the damping ratio of the control system can be varied from its initial low value to a final high value in a finite time. A low value of damping ratio will cause a quick response, and the later high damping ratio will avoid overshoot, and therefore the control performance can be optimized. First, a dynamics model of a quadrocopter is presented. Next, an SMC with an NSS is designed for tracking control of a quadrocopter. The stability of the proposed control system is proved based on the Lyapunov stability theory. The effectiveness of the proposed design is verified by simulation in which comparative results with the conventional linear sliding surface (LSS) is shown. The NSS is more effective compared to the conventional LSS when the disturbances exist.

January 31 (Thursday), 14:30–15:30

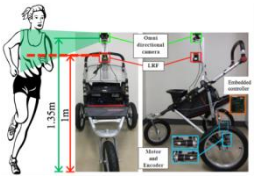
Room B

GS10 Mobile vehicles

GS10-1 Development of Outdoor Mobile Robot for Human Following Navigation

Jae Hoon LEE, Kei OKAMOTO, Masumi OUE, Shingo OKAMOTO
(Ehime University, Japan)

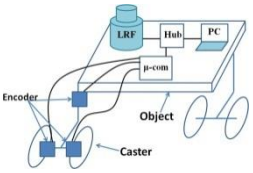
This paper deals with the development of a mobile robot for human following navigation in outdoor urban environment. Laser scanner and omni-directional camera were installed on the mobile platform for detecting people including a target person. The scan and image data from both sensors was fused into the information for tracking multiple moving objects, i.e. people. System configuration has been designed for effective collaboration between components operating in real-time. In order to follow the target, a motion control method based on the relative distance and velocity between the target and the robot itself. The proposed method was demonstrated through experiments of human following navigation with the developed robot in the outdoor environment of university campus.



GS10-2 Parameter Estimation Experiment and Development of Decentralized Caster Modules

Kazuyoshi Ohara, Jae Hoon Lee, Shingo Okamoto
(Ehime University, Japan)

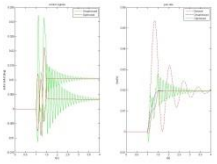
Parameter estimation method for distributed active caster has been investigated in this paper. By installing multiple active casters to a target object directly, it becomes a mobile system for transportation and can be moved to the goal position automatically. When the system is used to move an object of irregular shape, the position of each caster module should be estimated because it is basic parameter for control. Therefore, a parameter estimation method based on the kinematic model of each caster module and Kalman filter was proposed. The proposed algorithm has been demonstrated by computer simulation and experimental work.



GS10-3 Parameter optimization for decoupling controllers of 4WS vehicles

Mingxing Li, Haijing Xu, Yingmin Jia
(Beihang University, China)

In this paper, the performance analysis and parameter optimization for two typical decoupling controllers of the 4WS vehicles are considered. Firstly, a new relationship between velocity and acceleration in effect on the nonlinear performance is established. Then, for the decoupling controller of a quasi-linearized system, the optimized region of parameters is obtained, in which the damping is bigger than one and eigenvalues are smaller than any given negative number. For the decoupling controller of a linearized system, the necessary and sufficient condition that the overshoot and irritating are avoided is deduced by using a new index. And the region, the measurement-error disturbance is attenuated to under any given positive number, is obtained for any expected eigenvalues. Simulation results show that optimized controllers can improve the safety and comfort obviously.

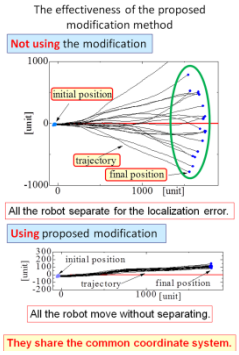


January 31 (Thursday), 14:30–15:30

GS10-4 A method of sharing for common coordinate system by using relative position among the swarm

Koji Makino
(Tokyo University of Technology, Japan)

I have proposed a method that the many robots share the common coordinate system using dead-reckoning and observation to other robots without communication and without making the maps, like migration animals. To share the common coordinate system, both position and direction is necessary to be considered. I analyzed the effectiveness of the directional modification method, and confirmed it by simulations. In this paper, the modification of the position is focused on. First, the effectiveness of the method is confirmed by simulations. Secondly, the influence of the coefficient parameter of the positional modification is investigated, when the number of the robots and modification interval are changed. As a result, it is found out that the modification method of the position has optimal values.



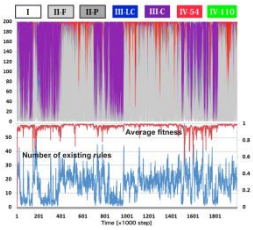
Room C

GS2 Artificial life and complexity

GS2-1 Non-uniform Cellular Automata based on Open-ended Rule Evolution

Noritsugu Sughimura, Reiji Suzuki, Takaya Arita
(Nagoya University, Japan)

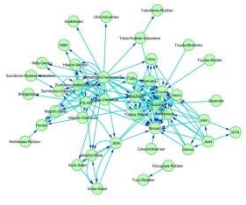
Cellular automata (CAs) are mathematical models of spatially and temporally discrete mathematical systems. Non-uniform CAs are the cellular automata in which each cell may contain a different transition rule and change it with time, while all cells share the same transition rule in regular CAs. Little is still known about the dynamics of open-ended evolution of rules in non-uniform CAs. The purpose of our study is to construct and investigate a model of non-uniform CAs capable of open-ended rule evolution exhibiting a wide variety of behavior across all Wolfram's classes. For this purpose, we construct 1-dimensional 2-state 3-neighborhood non-uniform CAs with evolving transition rules. In the model, we found an interesting dynamics that Class II (periodical behavior) and III (chaotic behavior) patterns emerged alternately, between which Class IV patterns sometimes emerged.



GS2-2 A Procedure for Constructing Social Network Using Web Search Engines: The Case for Japanese Automotive Industry

Yuchi Kubota, Reiji Suzuki, Takaya Arita
(Nagoya University, Japan)

Recently, search engines have enabled us to access immense quantities of useful information in an instant. In this paper, we propose a procedure for analyzing the social relationship and structure using Web search engines, which includes novel ways to create a search query and to use the number of hits. This allows us to construct various networks that reflect directed and undirected relationships among actors under arbitrary contexts.
As a case study for evaluations of the proposed procedure, we focus on 50 companies belonging to automotive industry in Japan. We constructed several directed and undirected networks under different temporal and geographical contexts. We show that we can obtain more general knowledge about this industrial community from the analyses of these created networks and their centrality measures.

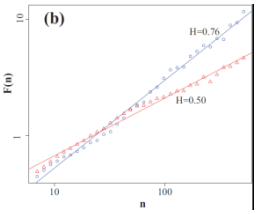


January 31 (Thursday), 14:30–15:30

GS2-3 Statistical Analysis for Price Changes of Carbon European Union Allowances

zeyu zheng[1], Kazuko yamasaki[1], Jun Yang[2]
([1]Tokyo University of information sciences, Japan)
([2]Chongqing University, China)

Recent years, several national and regional emission markets have been established, the carbon emission related assets already become an main investment goods. We analyzed the price changes time series of European Union allowances (EUA) futures in European Climate Exchange (ECX) market, which is the world's largest single market for CO2 emission allowances. We showed probability density function of price changes time series. We find that there are long-range correlations in the absolute of price changes (volatility). Further, detrended fluctuation analysis (DFA) approach is assessed with focus on long-range correlations and Hurst exponent. We find long-range power-law auto-correlations in the absolute of price changes (volatility) that quantify the size of risk, and find that they decay much more slowly than the auto-correlation of return time series. We also investigate the multi-fractal status of volatility of EUA time series. All results show that the EUA price change time series have very similar statistic properties as stocks price changes.



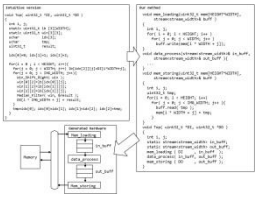
Room D

GS7 Image processing

GS7-1 A describing method of latency tolerant hardware for a pure ANSI-C/C++ based high-level synthesis technology

Akira Yamawaki, Seiichi Serikawa
(Kyushu Institute of Technology, Japan)

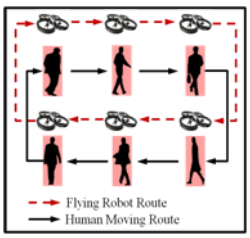
The image processing is important for the robotics and its hardware implementation is required in order to realize a small and low-power device with the appropriate performance where the high performance computer cannot be used due to the cost, size and power limitation. To reduce the burden of such hardware development, the high-level synthesis (HLS) technologies that automatically convert the algorithmic description to hardware have been proposed and developed. The combination of the memory latency hiding and data process pipelining is very important to extract the hardware performance maximally. However, nobody shows clearly how to describe the hardware behavior to generate such hardware. This paper shows a generic describing method for HLS technology based on ANSI-C/C++ that can realize the combination of the memory latency hiding and data process pipelining. The experimental results show that our method can be applied easily to the intuitive C program. The logic simulation and an FPGA implementation reveal the effects to the performance improvement and the hardware increase induced by our method.



GS7-3 A Research on State Recognition in Wide Area by Aerial Images Analysis

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

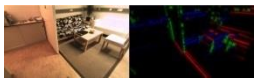
This paper proposes an autonomous monitoring system to track the subject in real time by using aerial images, novel image processing method, and helicopter control technique. In this study, flying robot named AR.Drone is used for solving the problem of insufficient tracking capability in previous studies. In order to track the subject correctly and control the flying robot in right direction, it is important to understand the information of the subject's moving direction. For calculating the moving direction correctly from aerial images, new method by integrating various kinds of modules is proposed. With experiments, the stability of human tracking capability and the effectiveness of the direction estimation by aerial images analysis is verified.



January 31 (Thursday), 14:30–15:30

GS7-4 Semantic Segmentation in Manhattan-like Environments from 2.5D data

Sven Olufs and Markus Vincze
(University of Technology / Automation and Control Institute, Austria)



In this paper we propose a novel approach for the robust segmentation of room structure using Manhattan world assumption. First, we estimate the Manhattan-like structure by using an MSAC variant that estimates such a Manhattan system directly from the data. Once the orientation is estimated we extract hypotheses of the room structure by exploiting 2D histograms using mean shift clustering techniques as rough estimate for a pre-segmentation of voxels ie. their membership to planes of a certain position and orientation. Additionally we use the concept of vanishing points to extract 2D cues from the 2.5D data to improve the segmentation. We apply superpixel over segmentation on the colour input to achieve a dense segmentation. The over segmentation and pre-segmented voxels are combined using graph-cuts for a not a-priori known number of final plane segments with a label minimizing graph cut variant with polynomial runtime.

January 31 (Thursday), 15:45–17:00

Room A

GS9 Learning

GS9-1 Cell-production parts layout by virtual factory system using reinforcement learning and MTM

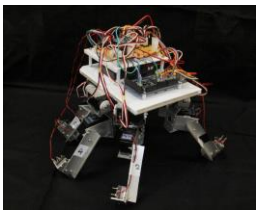
Hidehiko Yamamoto[1], Tsuyoshi Sugimoto[1], Takayoshi Yamada[1], Masahiro Nakamura[2]
([1]Gifu University, Japan)
([2]Lexer Research Inc, Japan)

For a cell production system to use a part rack for production environment, the quality of efficiency of the production time varies according to the part placement of the part rack. To solve this problem , we developed Virtual Assembly Cell-production System (VACS) which evaluates the movement distance of operators and decides part placement. In this study, we suggest a new VACS which evaluates not only movement distance of the operators but also up-and-down motion to get parts on the rack. In this VACS, by part placement decision, I adopt reinforcement learning and adopt the MTM as a work evaluation of the up-and-down motion of the rack in this reinforcement learning .

January 31 (Thursday), 15:45–17:00

GS9-2 Gait motion of a six legged real robot employing associatron

Masashi Sakai, Tomo Ishikawa, Masato Hashimoto, Tomo Ishikawa,
Koji Makino, Jin-Hua She, Yasuhiro Ohyama
(Tokyo University of Technology, Japan)



In this study, we have proposed gait motion algorithm of a six legged robot in order to walk an unpredictable irregular field. The algorithm is adapted to the Associatron. The algorithm has a property that enables the robot to recall an entire pattern from partial information, sequentially. Therefore, the robot can walk in unknown field. First, we verified the proposed algorithm by simulations using ODE (Open Dynamics Engine). It is clear that memorized pattern is recalled from unknown pattern. Secondly, an experiment is performed using the developed real robot. The experiment result proved that the robot is able to select suitable gait motion at the existence of an obstacle.

GS9-3 Modified Neural Q-Learning for Two-Wheeled Inverted Pendulum balancing Control

Yeon-Seob Kim, Ju-Jang Lee
(Korea Advanced Institute of Science and Technology, Korea)

Classic robotics and the almost recent robots still rely on fixed behavior based control. So, the recent paradigm of robots and robotics is increasing the robot's ability that can deal with uncertainties in the real world. One approach of the paradigm is learning from experience and creating appropriate adaptive control system. A general approach is Reinforcement Learning(RL). RL is a class of intelligent and robust methods to develop or improve the actions of the agent in a uncertain environment. By interacting with the environment, the agent learns and finds an optimal solution. To find the optimal solution, RL uses the value function. The value function is calculated using Bellman equation which is a nonlinear Lyapunov equation. But it is usually required knowledge of the system dynamics in order to solve for the value function. To avoid it, Q-Learning method for discrete space was introduced by Watkins. Another method is action dependent heuristic dynamic programming(AD HDP). AD HDP based on actor-critic structure was introduced by Werbos. But the actor-critic structure involves training of two or more function approximators. …

GS9-4 Reinforcement learning for dynamic environment: a classification of dynamic environments and a detection method of environmental changes

Masato Nagayoshi[1], Hajime Murao[2], Hisashi Tamaki[2]
([1]Niigata College of Nursing, Japan)
([2]Kobe University, Japan)

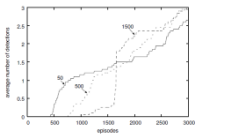


Fig. 4. Number of detections of 3 occurrence times of th environmental change

Engineers and researchers are paying more attention to reinforcement learning (RL) as a key technique for realizing computational intelligence such as adaptive and autonomous decentralized systems. In general, it is not easy to put RL into practical use. In prior research our approach mainly dealt with the problem of designing state and action spaces and we have proposed an adaptive co-construction method of state and action spaces. However, it is more dif cult to design state and action spaces in dynamic environments than in static ones. Therefore, it is even more effective to use an adaptive co-construction method of state and action spaces in dynamic environments. In this paper, our approach mainly deals with a problem of adaptation in dynamic environments. First, we classify tasks of dynamic environments and propose a detection method of environmental changes to adapt to dynamic environments. Next, we conducted computational experiments using a so-called “"path planning problem"” with a slowly changing environment where the aging of the system is assumed. The performances of a conventional RL method and the proposed detection method were con firmed.

January 31 (Thursday), 15:45–17:00

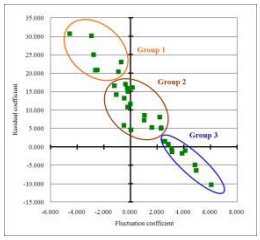
Room B

OS13 Kansei Engineering and its Applications

Chair: Tetsuo Hattori (Kagawa University, Taiwan)
Co-Chair: Yoshiro Imai (Kagawa University, Japan)

OS13-1 On a relation between feeling Impression and 3PACF of sound signal

Yusuke Kawakami[1], Tetsuo Hattori[1], Hiromichi Kawano[2], Tetsuya Izumi[3]
([1]Kagawa University, Japan)
([2]NTT Advanced Technology, Japan)
([3]Micro Technica Co., Ltd., Japan)



Recently, 1/f fluctuation has been actively researched in various fields related to signal analysis, especially in Kansei Engineering. It is said that the 1/f fluctuation brings about an effect of healing such that a human being psychologically feels at ease. However, we wonder if the feeling impression is strongly affected not only the value of fluctuation but also other factors. In this paper, we focus on three kinds of values as the feature quantity of sound signal: Fluctuation value (or Fluctuation), Intercept, and sum of squared errors (or Residual) what we call these parameters "3PACF" (3 Parameters Accompanying Calculation of Fluctuation). And, we investigate the relation between the 3PACF and feeling impression for 10 kinds of sound signal (i.e. music) by using questionnaire.

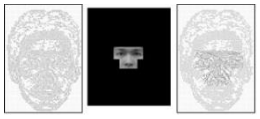
OS13-2 Color image arrangement by elastic transform based on histogram matching

Daisuke Kutsuna[1], Tetsuo Hattori[1], Yusuke Kawakami[1], Haruna Matsushita[1], Yoshiro Imai[1], Tetsuya Izumi[2]
([1]Kagawa University, Japan)
([2]Micro Technica Co., Ltd., Japan)

Aiming at automated affective color image arrangement, this paper proposes a new method using histogram based Elastic Transform (ET) on some kinds of axis including Lightness axis. If we represent a pixel of input image as a vector in the three-dimensional RGB color space, the input image corresponds to a set of the three-dimensional pixel vectors. As for axis other than the Lightness axis, there are PC axes that can be obtained by Principal Component Analysis (PCA) from the set of three-dimensional vectors. In this paper, we present a principle of the ET on the Lightness axis and PC one. We also illustrate that HMGD (Histogram Matching based on Gaussian distribution) is regarded as one of the ET method. In addition, for the investigation of the performance, we show the experimental results by applying the transform (especially HMGD) to some images.

OS13-3 Face identification insensitive to facial expression in the crowded people scene

Qingyu Shu[1], Tetsuo Hattori[1], Saki Masunari[1], Tetsuya Izumi[2], Hiromichi Kawano[3], Bahram Javidi[4]
([1]Kagawa University, Japan)
([2]Micro Technica Co., Ltd., Japan)
([3]NTT Advanced Technology, Japan)
([4]University of Connecticut, USA)

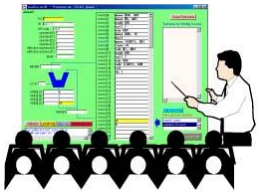


Face identification in the crowded people with various facial expressions is one of the most difficult themes in the pattern recognition field. In addition, the recognition of facial expression after the identification is very important as an advanced pattern recognition problem in Kansei Engineering field. Currently, there have been developed some methods at the level of practical use such as personal authentication. However, neither the theory nor the method has been established yet for the partial recognition problem that means the identification of a specific person's face from the crowd people scene. In this paper, we propose a novel face identification method insensitive to facial expressions using the notion of weighted vector field and weighted similarity. Also, we show the effectiveness by showing the experimental results.

January 31 (Thursday), 15:45–17:00

OS13-4 Kansei Engineering based evaluation for distance learning on distributed multiple servers

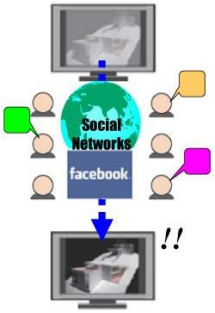
Yoshio Moritoh[1], Yoshiro Imai[2], Tetsuo Hattori[2]
([1]Kagawa Junior College, Japan)
([2]Kagawa University, Japan)



A distributed multiple server system is designed and implemented with Web-DB based services for Distance Learning as well as Emergency Communication. The system has employed multiple servers located in a distributed campus network environment. Each server of the system has multi-core processors. With virtualized CPUs by server virtualization, some programs are executed in parallel (on the virtual servers) so that our system can efficiently perform several functions. Based on our related works, two major applications are realized as a Cloud services on the system. It can provide Distance Learning environment for educational tool as well as Web-based surveillance functions with Emergency Contact. With Kansei Engineering approach, trial evaluation of system has been performed in some classrooms of distributed campus.

OS13-5 An application of Kansei Engineering to community-based collaboration

Masatoshi Imai[1], Yoshiro Imai[2], Tetsuo Hattori[2]
([1]Kagawa Junior College, Japan)
([2]Kagawa University, Japan)



This paper presents a proposal to reconstruct some specific towns which were attacked and destroyed by Huge Tsunami, for example, in Tohoku region of Japan on the 11th of March, 2011. A collaborative approach has been employed to provide some trial proposal to reconstruct such damaged towns by means of Internet Community as follows. (1) Providing a proposal and pictures to reconstruct, especially offering visual design concept of living space for slope topography through Social Network System as an example of Internet Community, (2) Consulting and discussing the above proposal and pictures among specific Internet Community with analysis by Kansei Engineering, and (3) Improving an original proposal into more efficient and suitable one. The paper also explains detail of the scenario to brush up the proposal by means of the above collaborative approach and some problems to be resolved in order to make it more fruitful.

January 31 (Thursday), 15:45–17:00

Room C

OS1 Artificial Life and Control

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

OS1-1 A Micro-Simulator for Traffic Signal Control Based on A Modified Cellular Automaton Traffic Flow Model

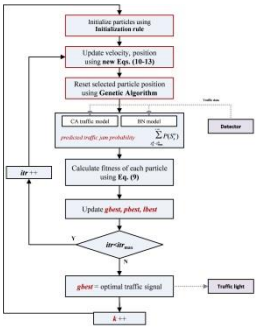
Hu Jin, Chengyou Cui, Hee-hyol Lee
(Waseda University, Japan)

In recent years, many traffic signal control methods have been proposed to reduce traffic jams. However, the experiments of the methods were difficult to perform in real road networks. In order to prove the effectiveness of the methods, traffic simulations by using a traffic simulator were required. Although various traffic simulators have been developed, the most of simulator was not specified for simulation of traffic signal control. A micro traffic simulator for simulation of traffic signal control is introduced in this paper. The micro-simulator is based on a Cellular Automaton (CA) model, which is a model of artificial life. Furthermore, the CA traffic model is modified according to features of traffic flows at intersections in order to reproduce the traffic situation of urban area. The usability of the proposed CA traffic model is evaluated through the analysis of relationship between traffic density, average speed, and traffic flows. Moreover, the micro-simulator is applied to evaluate traffic signal control methods.

January 31 (Thursday), 15:45–17:00

OS1-2 Real-Time Stochastic Optimal Control for Traffic Signals of Multiple Intersections

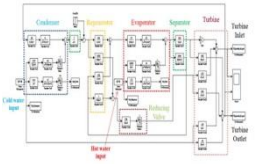
Chengyou Cui, Hee-hyol Lee
(Waseda University, Japan)



Traffic congestion has become a serious problem with exponential increase of vehicles recently. In urban area, almost all of traffic jams occur at intersections. In such cases, traffic signal control is a reasonable method to reduce the traffic jams. Traffic signal control can be divided into two types: one is off-line (Pre-timed) control and the other is on-line (Adaptive) control. In the pretimed control, empirical formulas were used to calculate the traffic signals off-line using historical traffic data, but it cannot handle the variation of traffic flows. The adaptive control can overcome this limitation by adjusting the traffic signals on-line in the various traffic flows. The adaptive control can also be divided into two types: centralized and distributed systems. However, the centralized system requires the extensive data processing and computational time to calculate optimal traffic signals. On the other hand, the distributed system can achieve a real time control. In this paper, a real time stochastic optimal control method of traffic signal is proposed. A modified Cellular Automaton (CA) traffic model and Bayesian Network (BN) model are used to predict the traffic jams. In addition, H-GA-PSO algorithm is used to search optimal traffic signals based on the stochastic model. The H-GA-PSO algorithm is a modified Hierarchical Particle Swarm Optimization (H-PSO) method based on Genetic Algorithm (GA). Finally, the effectiveness of the proposed method is shown through simulations at multiple intersections using a micro traffic simulator.

OS1-3 Decouple PID Control of Compact Binary Power Generation

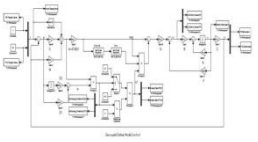
Kun-Young Han, Lu Li, Hee-Hyol Lee
(Waseda University, Japan)



A compact binary power generation using low-temperature difference thermal energy can be produce electric power by utilizing low temperature difference between hot water and cold water. In this study, a reduced transfer function model of whole transfer function model for the compact binary power generation pilot plant is constructed. A decouple PID control system is also designed to control the power generation pilot plant using a pseudo diagonalization, gershgorin bands, and multi-stage pre-compensators.

OS1-4 Decouple Sliding Mode Control of Compact Binary Power Generation

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



This paper presents a Decouple Sliding Mode Control(DSMC) of a compact binary power generation using low-temperature difference thermal energy.First, a state equation model based on the transfer function model is deduced. Then, a Sliding Mode Control system with decoupler is designed to control the pressure difference between inlet and outlet of a turbine by high pressure steam of working fluid. The validity of the proposed model is confirmed by a comparison between simulation and experimental result and the control simulation results show the effectiveness of the decouple Sliding Mode Control.

January 31 (Thursday), 15:45–17:00

Room D

GS11 Multi agent system

GS11-1 Evaluation of efficiency of the symmetry bias in grammar acquisition

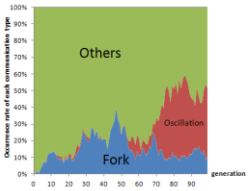
Ryuichi Matoba[1], Hiroki Sudo[1], Shingo Hagiwara[1], Satoshi Tojo[2]
([1]Toyama National College of Technology, Japan)
([2]Japan Advanced Institute of Science and Technology, Japan)

The aim of this study is to evaluate the efficacy of cognitive biases in grammar acquisition. So far, we have constructed Iterated Learning Model (ILM) in generation by generation, where a pair of a parent agent and an infant agent resides in a generation, and the infant becomes the parent of the next generation. Then, we have added the effect of such cognitive biases as symmetry bias and mutual exclusivity bias. Thus far, in evaluating results of acquired grammar, the expressivity and the number of grammar rules have been focused on. When we consider the efficacy of cognitive biases, however, we should observe how the infant agent could learn the parent agent¥'s intentions faithfully. Therefore, in this paper, we suggest assessing the difference of linguistic knowledge between a parent agent and an infant agenet, using Levenshtein distance. As a current result, we could observe that the distance becomes further in generations.

GS11-2 The Evolution of Pre-play Communication in the Interactive Minority Game

Keita Nishimoto[1], Ivan Tanev[2], Katsunori Shimohara[2], Reiji Suzuki[1], Takaya Arita[1]
([1]Nagoya University, Japan)
([2]Doshisha University, Japan)

Minority Game (MG) is an N-person game which represents the collective behavior of agents in an idealized situation in which they have to compete for some finite resource. MG has been studied actively in various fields, but most studies have not focused on the communication among agents. To study the evolution of communication in the MG, we extended the standard MG to a new game named Interactive Minority Game (IMG) by incorporating the two aspects: a continuous strategy space and a pre-play communication stage. In order to understand basic behaviors of agents in the IMG, we prepare three agents each of which is equipped with a recurrent neural network (RNN) to adjust the tentative strategy value in the pre-play communication stage and evolved the connection weights of each RNN based on the payoff of IMG. As a result, we saw the emergence of various communications such as the adaptive adjustment behavior and oscillation of strategy values of each agent. Moreover, we found the strategy differentiation among agents where two agents adopt "high-risk high-payoff" strategy and the rest one adopts "low-risk low-payoff".

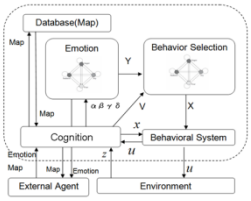


January 31 (Thursday), 15:45–17:00

GS11-3 A new decision-making system of an agent based on emotional models in multi-agent system

Shogo Watada[1], Masanao Obayashi[1], Takashi Kuremoto[1], Kunikazu Kobayashi[2], Shingo Mabu[1]
([1]Yamaguchi University, Japan)
([2]Aichi Prefectural University, Japan)

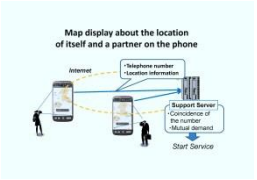
In this paper, a new behavioral decision method of the robot based on a Markovian emotional model is proposed and it is applied to environmental identification problem. Noting the role of emotion in communication, behaviors of multi-robot implementing the emotional transition model are optimized. The autonomous decentralized robot group with the proposed method is applied to identify an unknown environment. However, each robot in this autonomous decentralized system can communicate with other robots located within a certain distance. While searching and exploring the environment, each robot independently generates local topological maps, and uses the map for planning of actions. Finally, the effectiveness of the proposed method is verified using own simulator through evaluating the exploration time and the number of double-visited nodes for different complex environments.



GS11-4 Design of a user-support system for finding the other person talking on smart Phones

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

In this research, we designed a function to manage the position information using the smart phone's GPS, a function to manage a telephone call, and a support server that enables information sharing between smart phones. The function to manage a telephone call records the telephone number of the caller and the called persons. The support server recognizes the connection as a key for the telephone number information and determines the positions by sharing GPS information. A map showing the caller's position and that of the called person is then displayed on the screens of the smart phones during the telephone call.



February 1 (Friday), 08:30–10:15

Room A

OS5 Computer-Supported Learning Systems

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

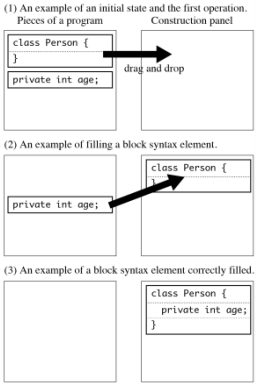
OS5-1 Development of entertainment based learning features in programming learning support system

Eiji Nunohiro, Masanori Ohshiro, Takashi Yamaguchi
(Tokyo University of Information Sciences, Japan)

In this research, we developed self learning programming support system called CAPTAIN that stimulates students' interest and motivation of their study continuously. When students use CAPTAIN, they feel that they are just like playing their computer games. In order to identify advantage and disadvantage or to investigate how to improve CAPTAIN, we are using CAPTAIN for the tutorials of a Java programming course. We developed an improved version of CAPTAIN, a learning programming support system which has the feature of entertainment. In this paper, we describe the overview of the proposed learning programming support system CAPTAIN3.4 which contains entertainment features, such as interactively showing animation and inciting the students to compete like their games. The proposed system has been applied to an actual university programming course and we evaluate the effect of this system by comparison between the students' progress with this system and that without using this system.

OS5-2 Programming learning support systems focused on structures of programming language and code

Masanori Ohshiro, Takashi Yamaguchi, Eiji Nunohiro
(Tokyo University of Information Sciences, Japan)



The authors have developed a programming training system CAPTAIN (Computer Aided Programming Training And INstruction). In this training system, each complete program is fragmented randomly into a few lines by the system. Students sort the lines as an original program similarly to solving a puzzle game.

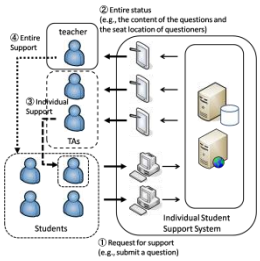
In this paper, we propose an advanced feature for the system. In order to write correct programs, students must know important structures of language's syntax. For example, block syntax is used for significant structures in Java. Therefore, in the new system, a program is divided into block syntax elements. First, contents of theses elements are empty except for their frame. Students are instructed to place them into correct position and to fill contents of the block syntax elements. It is expected that students will understand the structures of the programs in such process and their ability of writing programs will be improved.

February 1 (Friday), 08:30–10:15

OS5-3 Individual student support system for teacher and TAs using mobile devices in exercise classes

Masaki Hanada, Takashi Yamaguchi, Yasuo Nagai
(Tokyo University of Information Sciences, Japan)

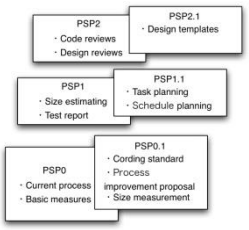
The paper describes a student support system for a teacher and Teaching Assistants (TAs) in order to support individual students effectively and satisfactorily in computer exercise classes. In general, a teacher teaches some classes in universities and several TAs engage in the activities to support students under guidance from a teacher in charge. Introduction of a student support system for a teacher and TAs is essential in order to support all the students effectively and satisfactorily by fewer teaching staff. In this research, we develop a system which visualizes the seat location of the questioner and shares the responses of questions, in order to answer students' questions during the class effectively and satisfactorily. In this paper, we report the proposed student support system and the results of the system evaluation.



OS5-4 Research on XP approach using The Personal Software Process Practices

Daisuke Yamaguchi
(Toin University of Yokohama, Japan)

Software architecture has emerged as an important sub disci-pline of software engineering. Personal Software Process (PSP) support system is built using this. Moreover, We think that the data inputted can ac-quire software development process by sorting out using a user action record table. In this paper, we propose the 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. 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 into the XP (eXtreme Programming) used on consciousness of flow. So, We can be conscious of process flow in every environment with development by this system can transmit pair program-ming to specific human among many software processes using Digital Assistant technology. Applying the proposed method to a personal process remove task, a flexible pro-gramming for quality of software.

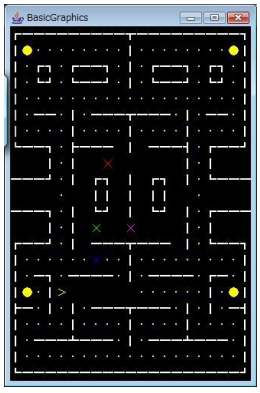


OS5-5 Non-event driven graphics API for programming education

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

Current multitasking window-based operating systems have adopted an event-driven model to support graphics and user interface control in application programs. But for beginner programmers, the idea of threads and event handling can be difficult to grasp, thus preventing beginner programmers for creating graphics applications, leaving programmers in the early stages to create simple text based console applications.

In this research, a non-event driven graphics API for programming education is proposed. By applying the proposed graphics API, programmers can create graphics and real-time user interface applications by simple state-request method calls not requiring any event handling or event call-back methods. The proposed graphics API also supports text based console I/O such as print line and line input, so beginner programmers can shift from console based applications to graphics applications without any paradigm changes.



February 1 (Friday), 08:30–10:15

OS5-6 An Education of Social Media Literacy to High School Students in Social Media Times

Yoshihiro Kawano[1], Takuya Miya[1], Naoki Furuya[1], Yuka Obu[2]
([1]Tokyo University of Information Sciences, Japan)
([2]Unicast Inc., Japan)

Social media, such as Twitter and Facebook, has been popularized to our society. In the social media times, many people become more active between online and offline. Today, personal branding is very important to harness an individual strong point. We are studying about the personal branding for high school and university students by practical use of social media. This research aims at a career design of the students by personal branding. Concretely, we gave lectures to high school students and teachers (junior high school, high school) about social media and personal branding. We conduct surveys about individual strong points and personal branding for high school students. As the result, we confirmed that they had improved literacy and understanding of social media. From this survey, we propose a personal branding support service named "Mentors". In the near future, Mentors may be launched.

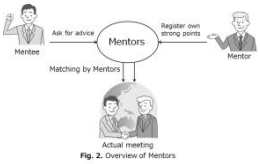
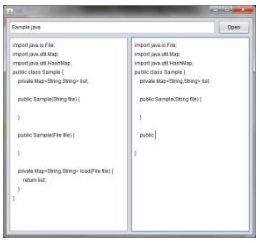


Fig. 2. Overview of Mentors

OS5-7 Syntax structure based typing tool for source code writing

Takashi Yamaguchi, Shinya Iwasaki, Kazuma Mori, Kenneth J. Mackin, Masaki Hanada, Eiji Nunohiro
(Tokyo University of Information Sciences, Japan)

Typing is a fundamental skill for the computer works that has the tasks of text inputting by keyboard. For improving computer work efficiency, the training of fast typing is very important. In this paper, we proposed a typing tool that presents a source code for the subject word. Proposed application has following three aims: the learning of touch typing, the learning of the syntax structure of programming language, the learning of source code writing process, and the improvement of continuity in programming language practice.
Our typing tool presents a part of source code for the subject words. The parts of source code is derived by blocks of syntax structure on programming language. These parts are presented by the sequences from super to sub nested blocks. From this source code presentation, the learner can feel the syntax structure and the writing process of expert programmers.



February 1 (Friday), 08:30–10:15

Room B

OS7 Control of Mechatronic System

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

OS7-1 Adaptive steering controller for vehicles with driving/braking force distribution

Bo Zhou, Masahiro Oya, Jinxin Zhuo, Panfeng Shu
(Kyushu Institute of Technology, Japan)

In this paper, we propose an adaptive steering controller with driving/braking force distribution of direct yaw-moment. To achieve good steering performance, a design scheme for ideal vehicle model is proposed. To consider the effects of the driver dynamics, in the scheme, numerical simulations including a driver model are carried out and an ideal vehicle model having good steering performance is designed by using a trial and error method. To realize the good steering performance also in the actual vehicles, an adaptive tracking controller is developed so that the behavior of the actual vehicle can track that of the designed ideal vehicle model.

February 1 (Friday), 08:30–10:15

OS7-2 Oscillation Control of a Contact Scanning Scanners System

Hideki Wada[1], Hiroyuki Koga[2], Katuhiro Okumura[3], Masahiro Oya[2]
([1]Sin-Nippon Nondestructive Inspection co., Japan)
([2]Kyushu Institute of Technology, Japan)
([3]Fukuoka Industrial Technology Center, Japan)

In the inspection of the deterioration state of the structures such as plants, contact scanning type sensors are useful devices. Using the sensors, we can check deterioration of structure and matter inside pipes during the production process. However, in case of the high-speed scanning, oscillation occurs in the sensor part due to unevenness and friction on the measured surface. In this paper, to overcome the problem, we propose an oscillation controller for scanning sensor systems. At last, to show the effectiveness of the proposed controller, numerical simulations are carried out.

OS7-3 Rollover Prevention Control of Driver-Heavy Vehicle Systems

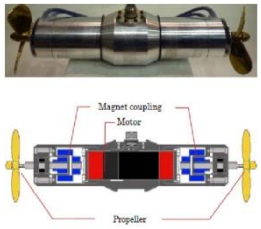
Yusuke Suetake, Masahiro Oya, Pangfeng Shu, Jinxin Zhou
(Kyushu Institute of Technology, Japan)

In this paper, we propose an adaptive rollover prevention controller. At first, using a evaluation function, we propose a design method for an ideal vehicle model achieving good rollover control performance even if driver's steering characteristics vary. Next, an adaptive tracking controller is developed so that the behavior of the actual heavy vehicle can track that of the ideal vehicle model.

OS7-4 Development of a dual-shaft propeller thruster equipped with rotational speed sensor for UVMS control

Radzi Bin Ambar, Shinichi Sagara, Takuya Yamaguchi
(Kyushu Institute of Technology, Japan)

Majority of underwater robots utilize single propeller thrusters for navigation. A disadvantage on using a single propeller thruster is the thrust force generated from a single propeller for reverse and forward thrust is asymmetric due to the disturbed flow caused by the thruster's body which may reduce thruster efficiency. Measurement procedures to precisely calculate propeller's rotation speed were also not available. To address these problems, this paper proposes a dual-shaft magnetic coupling driven propeller thruster for underwater vehicle-manipulator system (UVMS) equipped with sensors for measuring propeller's rotational speed. Numerical studies and experimental results on the position and orientation control of the proposed thruster are presented. Detail comparison of the rotational speed, thrust force and duty-ratio between numerical calculation and actual experimental measurement results shows the effectiveness of the proposed thruster. The ability to determine propeller rotation directions is also a major advantage.

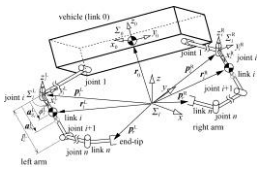


February 1 (Friday), 08:30–10:15

OS7-5 Control of a dual arm underwater robot

Shinichi Sagara, Radzi Bin Ambar, Kenichi Imaike
(Kyushu Institute of Technology, Japan)

Since Underwater Vehicle-Manipulator Systems (UVMS) are expected to make important roles in ocean exploration, many studies about control of single arm UVMSs have been reported. We have also been proposed a resolved acceleration control (RAC) method for a single arm UVMS. In this paper, we propose a RAC method for a dual arm UVMS. Simulation results show the effectiveness of the proposed control method.



Room C

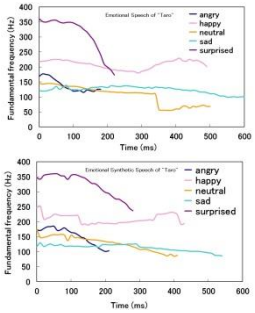
OS8 Facial Expression Recognition, Speech Synthesis of Emotions, and Music Recommendation

Chair: Yasunari Yoshitomi (Kyoto Prefectural University, Japan)
Co-Chair: Taro Asada (Kyoto Prefectural University, Japan)

OS8-1 Speech synthesis of emotions using vowel features of a speaker

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

Recently, methods for adding emotion to synthetic speech have received considerable attention in the field of speech synthesis research. We previously proposed a case-based method for generating emotional synthetic speech by exploiting the characteristics of the maximum amplitude and the utterance time of vowels, and the fundamental frequency of emotional speech. In the present study, we propose a method in which our reported method is further improved by controlling the fundamental frequency of emotional synthetic speech. As an initial investigation, we adopted the utterance of a Japanese name that is semantically neutral. By using the proposed method, emotional synthetic speech made from the emotional speech of one male subject was discriminable with a mean accuracy of 90.0% when 18 subjects listened to the emotional synthetic utterances of "angry," "happy," "neutral," "sad," or "surprised" when the utterance was the Japanese name "Taro."



OS8-2 A system for facial expression recognition of a speaker using thermal image processing and feature vector space characteristics

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

We developed an on-line system for the facial expression recognition of a speaker. In the feature vector space in image processing, the positions of feature vectors generated with imperfection, which caused misrecognition of facial expression, tended to be far from the center of gravity of the class to which the feature vectors belonged. In the present study, to omit the feature vectors generated with imperfection in image processing, a module using reject criteria in the feature vector space was added to the system for facial expression recognition. We adopted the utterance of the Japanese name "Taro," which is semantically neutral, to investigate the improved system. The facial expressions of one subject were analyzed when he exhibited one of the intentional facial expressions of "angry," "happy," "neutral," "sad," and "surprised." By using the facial expression strength, the position of the test feature vector in the feature vector space is shown.

		Input facial expression		
		Happy	Neutral	Others
Output	Happy	**100**		10.5
	Neutral		**100**	57.9
	Others			**31.6**
Rejected		7.5	0.0	59.2

Input facial expression	Facial expression strength					Nearest	Second nearest
	A	H	N	Sa	Su		
Angry	0.98	0.57	0.3	0.51	1	Su	A
Happy	0.21	1	0.26	0.61	0.2	H	Sa
Neutral	0.13	0.23	1	0.27	0.1	N	Sa
Sad	0.24	0.56	1	0.71	0.2	N	Sa
Surprised	0.68	0.45	0.24	0.38	1	Su	A

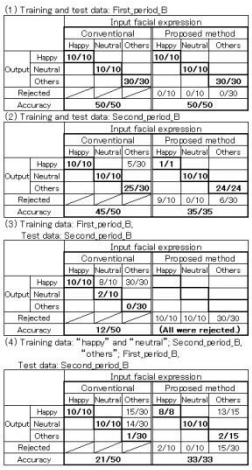
A=Angry, H=Happy, N=Neutral, Sa=Sad, Su=Surprised

February 1 (Friday), 08:30–10:15

OS8-3 Facial expression recognition of a speaker using thermal image processing and reject criteria in feature vector space

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

In our previously developed method for the facial expression recognition of a speaker, the positions of feature vectors in the feature vector space in image processing were generated with imperfections. The imperfections, which caused misrecognition of the facial expression, tended to be far from the center of gravity of the class to which the feature vectors belonged. In the present study, to omit the feature vectors generated with imperfections, a method using reject criteria in the feature vector space was applied to facial expression recognition. By using the proposed method, the facial expressions of two subjects were discriminable with 90.0% accuracy for the three facial expressions of "happy," "neutral," and "others" when they exhibited one of the five intentional facial expressions of "angry," "happy," "neutral," "sad," and "surprised," whereas these expressions were discriminable with 78.0% accuracy by the conventional method.



(1) Training and test data: First_period_B

		Input facial expression					
		Conventional			Proposed method		
		Happy	Neutral	Others	Happy	Neutral	Others
Output	Happy	10/10			10/10		
	Neutral		10/10			10/10	
	Others			30/30			30/30
Rejected					0/10	0/10	0/30
Accuracy		50/50			50/50		

(2) Training and test data: Second_period_B

		Input facial expression					
		Conventional			Proposed method		
		Happy	Neutral	Others	Happy	Neutral	Others
Output	Happy	10/10		5/30	1/1		
	Neutral		10/10			10/10	
	Others			25/30			24/24
Rejected					9/10	0/10	6/30
Accuracy		45/50			35/35		

(3) Training data: First_period_B, Test data: Second_period_B

		Input facial expression					
		Conventional			Proposed method		
		Happy	Neutral	Others	Happy	Neutral	Others
Output	Happy	10/10	8/10	30/30			
	Neutral		2/10				
	Others			0/30			
Rejected					10/10	10/10	30/30
Accuracy		12/50			(All were rejected.)		

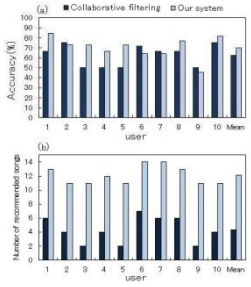
(4) Training data: "happy" and "neutral": Second_period_B; "others": First_period_B, Test data: Second_period_B

		Input facial expression					
		Conventional			Proposed method		
		Happy	Neutral	Others	Happy	Neutral	Others
Output	Happy	10/10		15/30	8/8		13/15
	Neutral		10/10	14/30		10/10	
	Others			1/30			2/15
Rejected					2/10	0/10	15/30
Accuracy		21/50			33/33		

OS8-4 Music recommendation hybrid system for improving recognition ability using collaborative filtering and impression words

Saya Yoshizaki[1], Yasunari Yoshitomi[2], Chikoto Koro[3], Taro Asada[2]
([1]Works Applications Co., Ltd., Japan)
([2]Kyoto Prefectural University, Japan)
([3]ISI Software Corp., Japan)

Music therapy for improving recognition ability may be more effective when the favorite music of each person is adopted. In the proposed system, first, the recommendation process using collaborative filtering is terminated when no users in the reference list have the same preference of recommended music as that of a new user. Then, the second recommendation process finds the most similar music, from the scores for impression words, to those successfully recommended among music not recommended up to the moment. The average number of recommended songs for each user by the proposed system was 12.1, whereas that of collaborative filtering was 4.3. The recommendation accuracy of the proposed system was 70.2%, whereas that of collaborative filtering was 62.1%. The ratings of songs can be added on a user-by-user basis in the recommendation process, and this increased number of cases improves the recommendation accuracy and increases the number of recommended songs.



February 1 (Friday), 08:30–09:30

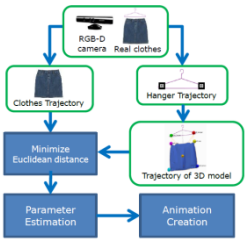
Room D

GS17 Virtual reality

GS17-1 Estimating the clothes characteristics with image and depth sensors for developing virtual fitting room

Yuka Matsuba[1], Jehan Jung[2], Hiroyuki Funaya[1], Kazushi Ikeda[1], Rammohan Mallipeddi[2], Minho Lee[2]
([1]Nara Institute of Science and Technology, Japan)
([2]Kyungpook National University, Korea)

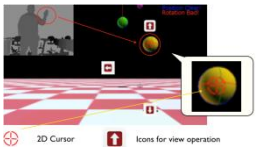
Creating physically simulated animations of real clothes is needed for virtual fitting rooms. In this paper, we propose a method for estimating the parameters of real clothes using the motion data obtained from a commercial RGB-depth sensor. Our method determines the parameters using simulated annealing so that the distance between the spatiotemporal trajectories of the real and the computer-simulated shapes of clothes. Here, the shapes of the clothes are expressed by several points identified by a feature-selection algorithm. In our experiments, the method showed a good reconstruction of motions of a skirt.



GS17-2 Spatial operation using skeletal recognition for virtual 3D work space

Yusuke Saito, Hiroyuki Nishiyama
(Tokyo University of Science, Japan)

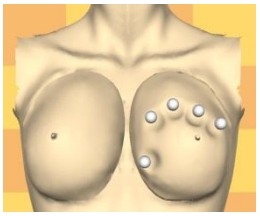
3D desktop application software for the general environment as well as professional work environment has been increasing. However, the input method for existing applications requires large-scale facilities and special equipment. This study proposes an operation method using skeletal recognition technology with depth information only. In addition, the method compares placement and specifying rotation tasks with the wheel mouse to verify its operability and to evaluate its efficiency and usability. The efficiency of the method, excluding the adjustment and some usability aspects was found to be good, but the overall efficiency was poor compared with using a mouse because the operation of the space is unstable and the estimated position of the skeleton was inaccurate.



GS17-3 Breast Cancer Palpation Training System Using Five-Fingered Haptic Interface Robot and GPGPU

Takamitsu Kawai, Tetsuya Mouri, Takahiro Endo, Haruhisa Kawasaki
(Gifu University, Japan)

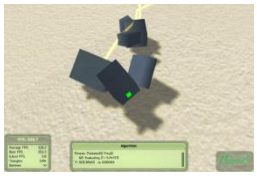
As the number of breast cancer patients grows, teaching more medical students is highly demanded than ever. However, seeking for real patients and actually having a training session with them are very difficult due to the nature of the training involving touching their body. Our approach to this problem is to develop a virtual breast cancer palpation training system that can completely eliminate the need for real human patients for the training. Our training system uses HandHIRO, a five-fingered haptic interface robot to create haptic sensations of the deformations of a virtual breast including tumors. The deformations of the virtual breast are entirely computed on a GPU using an FEM and the computational results are rendered both haptically using a HandHIRO and graphically using a 3D display system with a half mirror. In this paper, the design and implementation of our training system and preliminary experimental results are presented.



February 1 (Friday), 08:30–09:30

GS17-4 ALife approach for body-behavior predator-prey coevolution: body first or behavior first?

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



We present the results of morphology-behavior predator-prey coevolution in a 3D physically simulated environment. The morphology and behaviors of virtual creature predators and prey are evolved using a genetic algorithm and random one-on-one encounters in a shared environment. We analyze the evolutionary dynamics on the basis of quantitative characterization of morphology and behavior. Specifically, we pose and answer the question: Which precede the other, morphology or behavior, during the evolutionary acquisition of predator and prey strategies?

February 1 (Friday), 08:30–10:15

Room E

GS6 Human-welfare robotics

GS6-1 A study on the communication system using electrooculogram signals for persons with disabilities

Sou GO, Mingmin Yan, Hiroki Tamura, Koichi Tanno
(University of Miyazaki, Japan)

The aim of this study is to present electrooculogram (abbr. EOG) signals that can be used for human computer interface efficiently. Establishing an efficient alternative channel for communication without overt speech and hand movements is important to increase the quality of life for patients suffering from Amyotrophic Lateral Sclerosis or other illnesses that prevent correct limb and facial muscular responses. Using EOG signals, it is possible to improve the communication abilities of those patients who can move their eyes. Investigating possibility of usage of the EOG for human-computer interface, a relation between sight angle and EOG is determined. In other methodology, most famous approaches involve the use of a camera to visually track of the eye. However, this method has problems that the eyes of user must always be open. In this paper, we introduce the mouse cursor control system for Amyotrophic Lateral Sclerosis patients using EOG and electroencephalograph (abbr. EEG). We proposed the algorithm using alternating current and direct current of EOG corresponding to the drift. Therefore, our proposal EOG system did not have the problem of eye blinking artifacts, the displacement of electrode positions …

GS6-2 A study on the electric wheelchair hands-free control system using the laser range scanner

Takayuki Murata, Hiroki Tamura, Koichi Tanno
(University of Miyazaki, Japan)

This paper presents a semi-automatic control system for electric wheelchair using laser range scanner. The user of this system is supposed as severe disabilities paraplegic who cannot move the body under the neck. They can use the surface electromyography (s-EMG) of the facial muscle for controlling the electric wheelchair. When they are controlling the electric wheelchair with the s-EMG signals, to avoid the obstacle is difficult. Therefore, we developed the semi-automatic assist system for avoiding the obstacle. The proposed system is composed by laser range scanner. The electric wheelchair could increase safety by using our proposed assist system. We tried the experiments of driving in the hallway of the building. Our proposed system was confirmed that the electric wheelchair did not clash with the hallway of the building.

February 1 (Friday), 08:30–10:15

GS6-3 On driving assistance using forearm vibrotactile feedback for wheelchair drivers

Aydin Tarik Zengin, Kazuki Nabekura, Hiroshi Okajima, Nobutomo Matsunaga
(Kumamoto University, Japan)

Welfare devices are getting more popular along with the growing population of elder and disable. The significance of an easy to use wheelchair is rising recently. The authors have developed a new wheelchair using free-casters. Because of the growing importance of environmental safety, new driving assistance systems are required. A superficial vibrotactile feedback mechanism is designed to transmit environmental information to the wheelchair driver unlike the visual or audible signals that distract attention. Our goal is to develop a driving assistance system using vibrotactile feedback to the driver and to guarantee the safety. As a first step we evaluate simple vibrotactile system for the newly designed electric wheelchair. In this paper, we clarify the concept of vibration generation and propose a vibration feedback system. Also, we analyze the cognitive characteristics of vibration in order to show the effectiveness of the obstacle localization using vibrotactile feedback. It is expected that the drivers can easily estimate the location of environmental obstacles just by using the vibrotactile feedback. The effectiveness of the proposed system is confirmed by experiments.

GS6-4 Measurement and analysis of upper-limb essential tremor motion for tremor suppression with an exoskeleton robot

Yosuke Ono, Kazuo Kiguchi, Nobuhiro Okada
(Kyushu University, Japan)

An essential tremor is one of the most common tremor disorders of the arm and it may occur during a voluntary motion. Power-assist robots are useful for the physically weak persons to perform the daily motion. Although some power-assist robots are controlled based on electromyogram (EMG) signals, EMG signals are also influenced by the essential tremor. Therefore, when the user who suffers from the tremor uses the EMG-based controlled power-assist robot, the robot might magnify the vibration of the tremor. Although the tremor suppression control has been proposed for the EMG-based controlled power-assist robot to suppress the tremor in the hand position, the other part of the upper-limb might still vibrate since actual tremor movement of the upper-limb has not been analyzed precisely. Therefore, an upper-limb tremor sensing system is proposed to measure and analyze the precise tremor motion in this paper.

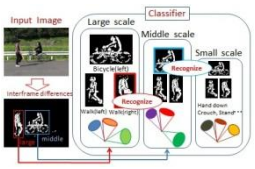
February 1 (Friday), 10:30–11:30

Room A

GS13 Pattern recognition

GS13-1 Simultaneous Recognition of Multiple Actions using CHLAC features

Kyosuke Masumitsu, Takayasu Fuchida
(Kagoshima University, Japan)



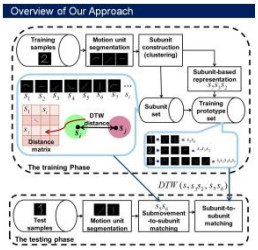
In this study, we propose simultaneous recognition of multiple actions in moving image using sub-space method and CHLAC features. As the CHLAC features are integral value of entire the image, it has the additivity. Thus, when multiple objects exist, it is possible to use the added-feature which is made by adding the each action of the object. But if you use such an added-feature, it becomes difficult to distinguish each action respectively. Then we introduce a method to trace the region of each object in the image. From the computer simulation by using these 8 kinds of moving images, we show that our proposed method can recognize these 8 kinds of actions.

February 1 (Friday), 10:30–11:30

GS13-2 Hand gesture recognition using subunit-based dynamic time warping

Yanrung Wang[1], Atsushi Shimada[1], Takayoshi Yamashita[2], Rin-ichiro Taniguchi[1]
([1]Kyushu University, Japan)
([2]OMRON Corporation, Japan)

A subunit-based Dynamic Time Warping (DTW) approach is introduced for hand movement recognition. Two major contributions distinguish the proposed approach from conventional DTW. (1) A set of hand movement subunits is constructed using a data-driven method. The learning is based on subunits instead of the whole hand movement for more efficient learning. (2) A more accurate similarity measure is offered using subunit-to-subunit matching to absorb the difference between two similar sub-sequences belonging to the same subunit, and only keeping the distances between sub-sequences that relate to different subunits. Compared with the conventional DTW approach, the proposed approach is experimentally demonstrated to be both accurate and efficient for locally collected datasets.



GS13-3 Mathematical modeling of mirror based passive moiré target for orientation sensing

Md. Mahbub Hasan, Satoshi Tanemura, Kenbu Teramoto
(Saga University, Japan)

Mirror based passive moiré target has been studied mathematically and numerically. Mathematical model of the passive moiré target at CCD camera sensor plate has been developed mathematical considering its orientations. Based on the mathematical model, the moiré patterns are simulated for the proposed passive target. The simulated resulted are compared to the moiré pattern produced by the existing passive moiré target. From the numerical results, it is found that the proposed passive moiré target exhibits better sensing capacities.

GS13-4 A study about interactive musical editing system for automatic piano: Inferring performance expression by considering tempos

Tomohiro Inoue, Eiji Hayashi
(Kyushu Institute of Technology, Japan)

We developed a system that allows a piano to perform automatically. To enable an automatic piano to play music with the emotional expression that a skilled human pianist can provide, all of the notes in the score must be arranged. The simulation of the emotional expression in an actual performance by a highly skilled pianist would take a great deal of time by a music editor, and in the present research, we structured an interactive music editing system to edit music more efficiently.
The system is based on a concept, "Similar-patterned phrases within the same composition are performed with similar emotional expression," and is composed of two systems: the "searching system of similar-patterned phrases" and the "inferring system of emotional expression in a performance."
In the searching system, we use dynamic programming (DP) matching as the method for searching for similar phrases. In the inferring system, we use Musical Rules Databases that contain information regarding the musical symbols used by pianists for inferring emotional expression in a performance.

February 1 (Friday), 10:30–11:30

Room B

GS16 Robotics III

GS16-1 A precision position arrangement of the SCARA robot by H∞ robust control

Yasuyuki Hirofuji, Feifei Zhang, Masanori Ito
(Tokyo University of Marine Science and Technology, Japan)

The SCARA (Selective Compliance Assembly Robot Arm) robot is playing an active role in many manufacturing stages of electrical machinery, electronic components etc. In those days, improvement of productivity is becoming important subject. And it will be realized with improvement in a capacity utilization rate, and industrial accident prevention, development of the technology for speed up of motion, accuracy of operation, or abnormality detection. Especially speed, accuracy and safety are most important items for it. We applied modern control theory, such as H∞ robust control and confirmed the performance with experiments.

GS16-2 Hybrid control with adaptive and state feedback control for Robot Hand

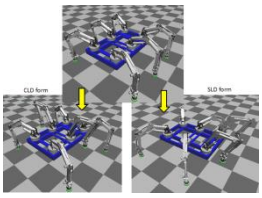
Kazuma Funahashi, Hiroki Goto, Feifei Zhang, Masanori Ito
(Tokyo University of Marine Science and Technology, Japan)

In this research, we aimed to get an optimum control performance for any kinds of system with the combination of adaptive and state feedback control which are one of modern control theory. Here we used "Gifuhand" which is a hand type robot of 5 fingers as an experimental device. It is optimum experimental device for the purpose of this research to develop the control method which does not spoil controllability under any condition. Because it is the structure imitating human's hand and it is possible to be applied in various scenes. The results of performance such as robustness and accuracy are satisfiable.

GS16-3 Hexa-Quad Transformation Control for Hexapod Robot Based on Support Polygon Pattern

Addie Irawan[1], Yee Yin Tan[1], Mohd Syakirin Ramli[1], Mohd Riduwan Ghazali[1], Kenzo Nonami[2]
([1]University Malaysia Pahang, Malaysia)
([2]Chiba University, Japan)

This paper presents a leg reconfigurable technique to optimize the multi-legged robot operation and walking performances. A hexapod-to-quadruped (Hexa-Quad) transformation technique is proposed to optimize hexapod legs on certain situation that need some legs to be disabled as a leg to do other tasks/operations. By separating two legs from the others, hexapod robot is able to be configured as quadruped robot configuration. Quadruped robot configuration is stand within dynamically and statically stable criteria if compare to the hexapod robot that has only statically stable criteria. Thus, it is very crucial to have a stable transformation technique during walking and operation session. Therefore Hexa-Quad is proposed with reference to the defined support polygon that based on its body area. A real-time based model of hexapod robot (4-DOF/leg) control architecture with Hexa-Quad transformation is designed and verified using separated 3D simulators.

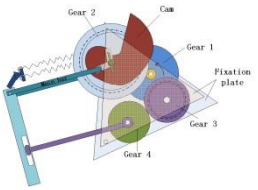


February 1 (Friday), 10:30–11:30

GS16-4 Design of a special cam-based high speed manipulator system

Jing Wu, Rui-Jun Yan, Kyoosik Shin, Chang-Soo Han
(HanYang University, Korea)

In this paper, we develop a mechanism that mainly used a special cam and gearbox to utilize a DC servo motor powerfully and speedily for a linkage manipulator. The mechanisms can be charged slowly, store the energy in a spring and release it on demand using a click mechanism. By compared the motions with many cams, we designed our special cam that can output an explosive movements. Two torsion springs, used as elastic elements, are located on the manipulator axis which is connected to the main link and the mechanism. Consider about the output of a manipulator, we choose to implement a four bar linkage design for the motion and force control. The manipulator's mathematic models are built for purposed of analysis and control.



Room C

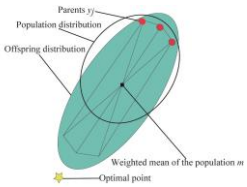
GS3 Artificial living

GS3-1 A Real-Coded Genetic Algorithm Taking Account of the Weighted Mean of the Population

Naotoshi Nakashima, Yuichi Nagata, Isao Ono
(Tokyo Institute of Technology, Japan)

Continuous function optimization is an important problem in science and engineering. The real-coded genetic algorithm (RCGA) has shown good performance in continuous function optimization. AREX/JGG is one of the most promising RCGAs. However, we believe that AREX/JGG has two problems in terms of search efficiency.

In this paper, wepropose a new RCGA that overcomes the problems of AREX/JGG. In order to examine the effectiveness of the proposed RCGA, we compared the performance of the proposed RCGA with that of AREX/JGG on several benchmark problems in which initial populations do not cover the optimal points. As the result, we confirmed that the proposed RCGA succeeded in finding the optimal points faster than AREX/JGG.



GS3-2 Diesel Engine Fuel Injection Control with DDVC Hydraulic System

Xing Jin, Feifei Zhang, Masanori Ito, Kyoko Narukawa
(Tokyo University of Marine Science and Technology, Japan)

Internal-combustion engine has used on ship, automobile and so on. However increase of internal-combustion engine caused to the environmental and energy problem in those days. Then we must improve the performance of it from the level of combustion. From this point of view, we put the target on a diesel engine which is usually used on ship as the main propulsion engine. Its performance is depending on a fuel injection system and it is well known that controlling injection optimally reduce the fuel consumption and amount of toxic substance. In those days, common rail type injection system using electro-magnetic valve or hydraulic injection system using electro-magnetic servo-valve for injection valve are applied to actual diesel engine and proved the effects. However those systems are expensive and complex, then more simple and lower cost system is expected.

In this study, we proposed a new Fuel injection system using Direct Drive Volume Control (DDVC) Hydraulic System, and developed basic control method for fuel injection. DDVC Hydraulic system is a new hydraulic system which is using servo-motor driven hydraulic pump and control the flow rate with changing the revolution of motor instead of electro-magnetic servo-valve. The new fuel injection system is constructed with conventional injection valve and new fuel pump using DDVC Hydraulic system. We have already established the method to control fuel injection timing, duration, pressure, rate and pattern.

February 1 (Friday), 10:30–11:30

GS3-3 The Complex Network Study of Money and CO2 Emission Flows between Industrial Sectors in Asian Countries using Input-Output Table

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

In 2011, earthquakes in Japan and flood in Thailand revealed the serious risks that local break downs of "motor vehicle sector" and "electronic computing sector" cause the cascade breakdown of world economy. To estimate such risks, it seems that connections between international industry sections are important and recently developed complex networks method is suitable for this study. We use the data of the input-output table of Asian countries and USA made by Jetro in 1990, 1995 and 2000. We regard the table as network matrix and make various directed weighted networks. In these networks, the nodes correspond to each industry sector in a country and the weight of the link corresponds to the amount of the money which uses the product of an industry sector as material to produce the product of another industry sector. We found how the economy of Asian countries has changed visually from 1990 to 2000. Main players in 1990 and 1995 are Japan and USA and China appears in 2000. Main nodes which have heavy total weight of the links are "other service sector" and "wholesale and retail trade sector" in USA …

GS3-4 On a serendipity oriented recommender system based on folksonomy

Hisaaki Yamaba, Michihito Tanoue, Kayoko Takatsuka, Naonobu Okazaki, Shigeyuki Tomita
(University of Miyazaki, Japan)

This paper proposes a recommendation method that focuses on not only predictive accuracy but also serendipity. On many of the conventional recommendation methods, each item is categorized according to their attributes (a genre, an authors, etc.) by the recommender in advance, and recommendation is performed using the categorization. In this study, impressions of user to items are adopted as a feature of the item, and each item is categorized according to the feature. The impressions are prepared by using folksonomy. A recommender system based on the method was developed by java language, and the effectiveness of the proposed method was verified through recommender experiments.

February 1 (Friday), 9:45-10:45

Room D

OS2 Bio-inspired Theory and Applications

Chair: Kunihito Yamamori (University of Miyazaki, Japan)

OS2-1 Diffusion model analysis of OneMax problem

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

A mathematical study is carried out for Genetic Algorithm (GA) on OneMax function within the framework of diffusion model. By using a partial differential equation, we obtain a distribution of the first order schema frequency. We consider the probability that a population includes the optimum solution by applying Markov chain model. We call this probability as the success probability of GA. Effects of mutation on the success probability were studied analytically and experimentally.

February 1 (Friday), 9:45-10:45

OS2-2 Study of factor IX gene using regional structure

Hiroshi Furutani, Kenji Sueyoshi, Kenji Aoki, Kunihito Yamamori, Makoto Sakamoto
(University of Miyazaki, Japan)

There have been reported a variety of defects in the factor IX gene, which is responsible for hemophilia B, and these are summarized in the hemophilia B database. We analyzed amino acid changing mutations, or missense mutations in the database described with factor IX activity values. We have carried out several kinds of theoretical studies to predict the effect of a missense mutations in Factor IX gene. In this paper, we report results of the analysis using Support Vector Machine. We applied the method of transfer learning, which uses the knowledge of some domain to predict the properties of other domains. As a training set, we use mutations of one of seven regions, and test the obtained parameters by the prediction of mutations in remaining regions.

OS2-3 Remarks on Recognizability of Four-Dimensional Topological Components

Makoto SAKAMOTO[1], Makoto NAGATOMO[1], Tatsuma KUROGI[1], Takao ITO[2], Yasuo UCHIDA[2]
Tsunehiro YOSHINAGA[3], Satoshi IKEDA[1], Masahiro YOKOMICHI[1], Hiroshi FURUTANI[1]
([1]University of Miyazaki, Japan)
([2]Ube National College of Technology, Japan)
([3]Tokuyama College of Technology, Japan)

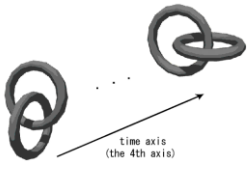
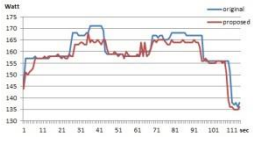


Fig1:Four-Dimentional Topological Components.

It is conjectured that four-dimensional pattern processing has its difficulties not arising in two- or three-dimensional case. One of these difficulties occurs in recognizing topological properties of four-dimensional patterns because four-dimensional neighborhood is more complicated than two- or three-dimensional case. Generally speaking, a property or relationship is topological only if it is preserved when an arbitrary 'rubber-sheet' distortion is applied to the pictures. For example, adjacency and connectedness are topological ; area, elongatedness, convexity, straightness, etc. are not. In recent years, there have been many interesting papers on digital topological properties. For example, an interlocking component was defined as a new topological property in multi-dimensional digital pictures: Let S1 and S2 be two subsets of the same four-dimensional digital picture. S1 and S2 are said to be interlocked when they satisfy the following conditions: (1) S1 and S2 are toruses, (2) S1 goes through a hole of S2, and (3) S2 goes through a hole of S1. On the other hand, four-dimensional information processing has also become of increasing interest with the rapid growth of dynamic picture processing, computer animation, computer tomography, virtual reality, robotics, and so on. Thus, the study of four-dimensional automaton as the computational model of four-dimensional pattern processing has been meaningful. In this paper, we deal with recognizability of topological components in four-dimensional patterns by computational models, and investigate some properties.

OS2-4 Power Consumption Reduction by Dynamic Core-counts Control with Power Gating

Kazuyuki Tamoto, Kunihito Yamamori, Masaru Aikawa
(University of Miyazaki, Japan)



Power Gating (PG) technology is known that it reduces static power consumption by leakage current. Linux operating system on multi-core processor evenly assigns processes to each core. Linux scheduler assigns processes to the core which has the fewest number of processes even if the core is idle. It makes an idle core in PG state change to active state, and avoids reducing power consumption. In this paper, we propose a method to reduce electric power consumption by effective use of PG. Our method modify linux kernel to change number of active cores in system dynamically, and apply PG to idle cores immediately. The number of active cores is changed according to the system load. Experimental results show that our proposed method reduces about 8kWh electric power consumption from the original kernel with keeping performance.

February 1 (Friday), 11:00-11:30

Room D

OS14 Applications and Theories of Advanced Technology

Chair: Takao Ito (Ube National College of Technology, Japan)

OS14-1 Bottom-Up Pyramid Cellular Acceptors with n-Dimensional Layers

Makoto SAKAMOTO[1], Tatsuma KUROGI[1], Makoto NAGATOMO[1], Takao ITO[2], Yasuo UCHIDA[2], Tsunehiro YOSHINAGA[3], Satoshi IKEDA[1], Masahiro YOKOMICHI[1], Hiroshi FURUTANI[1],
([1]University of Miyazaki, Japan)
([2]Ube National College of Technology, Japan)
([3]Tokuyama College of Technology, Japan)

The study of four-dimensional automata as the computational model of four-dimensional pattern processing has been meaningful. From this point of view, we are interested in four-dimensional automata, and we dealt four-dimensional case about bottom-up pyramid cellular acceptors in 2011. In this paper, we investigate about bottom-up pyramid cellular acceptors with n-dimensional layers, and generalize conventional results in n dimension. Specifically, we deal with the following problems (which is one of the open problems): Does the class of sets accepted by deterministic bottom-up pyramid cellular acceptors with n-dimensional layers include the class of sets accepted by deterministic n-dimensional finite automata? This paper shows that the class of sets accepted by n-dimensional finite automata is incomparable with the class of sets accepted by deterministic bottom-up pyramid cellular acceptors which operate in time of order lower than the diameter of the input.

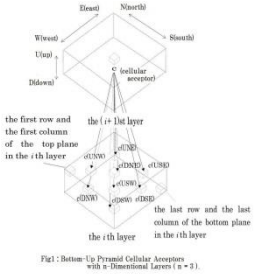
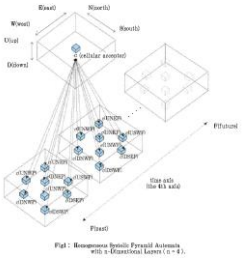


Fig1 : Bottom-Up Pyramid Cellular Acceptors with n-Dimensional Layers (n = 3).

OS14-2 Homogeneous Systolic Pyramid Automata with n-Dimensional Layers

Makoto SAKAMOTO[1], Takao ITO[2], Tatsuma KUROGI[1], Makoto NAGATOMO[1], Yasuo UCHIDA[2], Tsunehiro YOSHINAGA[3], Satoshi IKEDA[1], Masahiro YOKOMICHI[1], Hiroshi FURUTANI[1],
([1]University of Miyazaki, Japan)
([2]Ube National College of Technology, Japan)
([3]Tokuyama College of Technology, Japan)

A homogeneous systolic pyramid automaton with n-dimensional layers (n-HSPA) is a pyramid stack of n-dimensional arrays of cells in which the bottom n-dimensional layer (level 0) has size an ($a \geqq 1$), the next lowest (a-1)n, and so forth, the (a-1)st n-dimensional layer (level (a-1)) consisting of a single cell, called the root. Each cell means an identical finite-state machine. The input is accepted if and only if the root cell ever enters an accepting state. An n-HSPA is said to be a real-time n-HSPA if for every n-dimensional tape of size an ($a \geqq 1$) it accepts the n-dimensional tape in time a-1. Moreover, a 1-way n-dimensional cellular automaton (1-nCA) can be considered as a natural extension of the 1-way two-dimensional cellular automaton to n-dimension. The initial configuration is accepted if the last special cell reaches a final state. A 1-nCA is said to be a real-time 1-nCA if when started with n-dimensional array of cells in nonquiescent state, the special cell reaches a final state. In this paper, we propose a homogeneous systolic automaton with n-dimensional layers (n-HSPA), and investigate some properties of real-time n-HSPA. Specifically, we first investigate a relationship between the accepting powers of real-time n-HSPA's and real-time 1-nCA's. We next investigate the recognizability of n-dimensional connected tapes by real-time n-HSPA's.



February 1 (Friday), 10:30–11:30

Room E

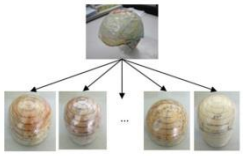
OS12 Intuitive Human-System Interaction

Chair: Masao Yokota (Fukuoka Institute of Technology, Japan)
Co-Chair: Kaoru Sugita (Fukuoka Institute of Technology, Japan)

OS12-1 Automatic identification of 3-D shape of head for wig manufacture

Yonghu Zhu, Yoshiaki Adaniya, Kazuhiro Tsujino, Cunwei Lu
(Fukuoka Institute of Technology, Japan)

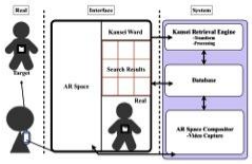
When making an order-made wig, in order to reduce cost, production of wig is performed in overseas factory where personnel expenses are usually cheap. In order to send the information of customer's head to the overseas factory, a wrap-model is often used. There are two problems in this method, one is that the production cycle time is too long, and another is that when the wig is damaged it is inconvenient for re-production. The aim of our research is to propose a wig manufacture system whose production cycle is short and re-production of the wrap-model is convenient. The key point is using three-dimensional (3-D) information instead of the customer's wrap-model. We use the 3-D image measurement method based on Optimal Intensity-Modulation Pattern (OIMP) projection technique to obtain each side of the wrap-model, and then synthesize it to represent the entire wrap-model. Then we send the 3-D information of the wrap-model to overseas factory by using the internet. In the overseas factory, according to the 3-D information of the wrap-model, we select one mold which is the fittest to produce the wig. Now, we are developing the application of the proposed method.



OS12-2 Retrieval method for augmented reality objects based on color impression

Kazunori Nakamura, Kaoru Sugita, Masao Yokota
(Fukuoka Institute of Technology, Japan)

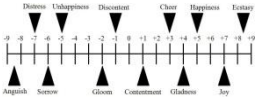
In this paper, we propose a retrieval method for Augmented Reality (AR) objects based on color impression. In this method, AR objects can be retrieved by Kansei words and superposed on a live video at the positions specified dynamically by users in use of special markers. The retrieval method employs color information such as RGB value and ratio of the color in the texture. We are implementing a virtual clothes fitting software as a smart-phone application.



OS12-3 Preparatory data analysis for customer servicing interface of Buddhism statue ordering system

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

The authors have proposed a human mind model consisting of Stimulus, Knowledge, Emotion and Response Processing Agents and simulated human-robot communication based on it. This paper describes artificial Kansei, namely, Kansei for a robot as tight collaboration of Knowledge and Emotion Processing Agents of our mind model, and verbalization of affective information so called Kansei expression by Response Processing Agent, focusing on basic analysis of Kansei words for the customer servicing interface of a Buddhism statue ordering system under development.



February 1 (Friday), 10:30–11:30

OS12-4 Toward multimodal user interface for intuitive interaction with Buddhism statue ordering system

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

The authors have been developing a Buddhism statue ordering system which enables customers to use affective words such as peaceful and divine, intending to specify the facial expressions of their favorite statues. Such affective words, however, are bound to vague and ambiguous specification of their demands. This paper proposes an innovative two-staged specification method allowing customers to elaborate their demands by graphical inputs following Kansei words.