

Abstract Collection of

NCSP 2023

RISP International Workshop on Nonlinear Circuits,
Communications and Signal Processing 2023

February 28 - March 3, 2023, Honolulu, Hawaii

(Hybrid Conference)

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Research Institute of Signal Processing, Japan

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Greeting Message from General Co-Chair



Hiroo Sekiya
Chiba University, Japan
General Co-Chair, NCSP2023



Tetsuya Shimamura
Saitama University, Japan
General Co-Chair, NCSP2023

Dear Friends and Colleagues,

On behalf of the Organizing Committee, it is our great honor to welcome you to the 2023 International Workshop on Nonlinear Circuits, Communications and Signal Processing (NCSP'23), to be held at the Alamoana Hotel, Honolulu, Hawaii, from February 28 to March 3, 2023. This conference is organized by the Research Institute of Signal Processing (RISP), Japan.

NCSP was established to provide a forum for the exchange of the latest results related to nonlinear circuits, communications, and signal processing, from fundamentals to applications in various fields of science and engineering, reflecting the multidisciplinary nature of the topics and activities. The hard work of the Technical Program Committee allowed preparing a very high-quality scientific program for the delegates, reflecting the wide range of topics and the growing research interests in the field. As a result, we accept 130 excellent papers to be in the technical program of NCSP'23.

We would like to take this opportunity to thank all the members of the organizing committee, technical program committee co-chairs, all the authors who decided to submit their papers to NCSP2023, and so many reviewers who made the selection of the best papers and the student paper awards. We believe that we have achieved our goal of providing a conducive environment for participants to discuss significant developments that will contribute to the evolution of their research areas.

Due to the COVID-19 pandemic, NCSP'20 canceled the face-to-face meeting, and NCSP'21 and 22 were held as online conferences. This is the first in-person NCSP since the pandemic. We believe that face-to-face discussions and interactions stimulate participants and lead to the generation of new ideas. We also prepared the online sessions. Information technology eliminates the problem of physical distance. Hosting the NCSP in a hybrid format is challenging, but we hope it will add value to the NCSP.

We sincerely hope that NCSP'23 will provide you not only with the wonderful experience of a technology conference but also a place to meet old friends, make new ones, and enjoy the Hawaiian culture.

Welcome to NCSP'23!
Welcome to Hawaii!

Sincerely yours,
General Co-Chairs

A handwritten signature in cursive script that reads "Hiroo Sekiya".

Hiroo Sekiya (Chiba University, Japan)

A handwritten signature in cursive script that reads "Tetsuya Shimamura".

Tetsuya Shimamura (Saitama University, Japan)

2023 RISP International Workshop on Nonlinear Circuits, Communications and Signal Processing (NCSP'23)

Organizer:

Research Institute of Signal Processing, Japan (RISP)
<http://www.risp.jp/>

In Cooperation with:

Acoustic Society of Japan (ASJ)

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Session Schedule

For Virtual Presentations

	Zoom Meeting Room 1	Zoom Meeting Room 2	Zoom Meeting Room 3
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28 Feb., 16:00 - 18:00 HST (1 Mar., 11:00 - 13:00 JST)	28PM2-1: Nonlinear Circuits and Systems 1 Page 9	28PM2-2: Artificial Intelligence and Machine Learning 2 Page 11	28PM2-3: Signal Processing Page 12
28 Feb., 19:00 - 21:00 HST (1 Mar., 14:00-16:00 JST)	28PM3-1: Wireless Communication Systems 2 Page 14	28PM3-2: Artificial Intelligence and Machine Learning 3 Page 15	

- Times in Hawaii time (HST), GMT -10 hours
- (Times): Times in Japan time (JST), GMT +9 hours

For Onsite Presentations

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1 March, 09:00 - 10:40	1AM1-1: Nonlinear Circuits and Systems 2 Page 16	1AM1-2: Artificial Intelligence and Machine Learning 4 Page 17	
1 March, 11:00 - 13:00	1AM2-1: Nonlinear Circuits and Systems 3 Page 18	1AM2-2: Sound and Speech Processing Page 19	1AM2-3: Wireless Communication Systems 3 Page 21
March 1, 14:00-15:40	1PM1-1: SS2. Neural Prosthesis and WiBIC 1 Page 22	1PM1-2: Artificial Intelligence and Machine Learning 5 Page 23	1PM1-3: Communication & Sensor Networks Page 24
1 March, 16:00 - 17:40	1PM2-1: SS2. Neural Prosthesis and WiBIC 2 Page 25	1PM2-2: Image & Video Signal Processing Page 26	1PM2-3: SS1. Recent Progress of VLC for 6G Page 27
2 March, 09:20 - 10:40	2AM1-1: Nonlinear Applications Page 28	2AM1-2: Artificial Intelligence and Machine Learning for Time Series Page 29	
2 March, 11:00-12:40	2AM2-1: Wireless Communication Systems 4 Page 30	2AM2-2: Applications of Signal Processing Page 31	
3 March, 11:00 - 13:00	3AM1-1: Bifurcation and Chaos Page 32	3AM1-2: Artificial Intelligence and Machine Learning for Image Processing Page 33	

- Times in Hawaii time (HST), GMT -10 hours

Abstracts

28PM1-1: Wireless Communication Systems 1

Date: 28 February, 2:00pm to 3:40pm HST (1 March, 9:00am to 10:40am JST)

Room: Zoom Meeting Room1

Chair: Wenqi Zhu (Chiba University)

28PM1-1-1 Identification for Sink Devices Using CNN Based on the Received and Supplied Power Waveform During the USB-PD Negotiation Process

Proc. pp. 1-4

Takumi Wada (Kanagawa Institute of Technology), Haruhisa Ichikawa (The University of Electro-Communication), Yoshito Tobe (Aoyama Gakuin University), Shinji Yokogawa (The University of Electro-Communication), Yuusuke Kawakita (Kanagawa Institute of Technology)

In this study, we propose a method for identifying the sink device types connected to a virtual grid (VG) system using the supplied power waveform during negotiation. VG systems can provide a stable electricity supply anywhere, with or without a wired power grid. One of the objectives of this VG system is to improve user convenience. Accordingly, the health must be diagnosed, and the sink devices must be identified to determine their supply priority and power allocation. A common method of acquiring device information is to install applications on the devices to be connected. However, this method requires the development of applications that can run on multiple platforms and address vulnerabilities in all devices. Therefore, a method for identifying the sink device types connected to the VG system without introducing applications is necessary. In the USB-power delivery (PD) negotiation, the specification allows the receiver to communicate the device information. However, only a few devices correctly transmit the device information, making it difficult to identify the connected device from the device information during the negotiation. In addition, the supplied power waveform over a certain period differs, even for the same device, depending on whether or not the application is running and on the charging circuit design. We propose herein a method for identifying the sink device types connected to a VG system using the supplied power waveform during negotiation.

28PM1-1-2 A Study on Tracking and Notification of Human Motion using LiDAR Sensors

Proc. pp. 5-8

Yuki Matsuo (Konan University), Masahiro Wada (Konan University)

Mobile robots are playing an active role not only in our living spaces but also in various other situations. This is because various sensors have become available. There are many approaches that a mobile robot detect a self position and human obstacles moving in the space using several sensors. Robots usually need an environmental map to recognize space in several spaces for several purposes which technology is called SLAM (Simultaneous Localization and Mapping). SLAM and human detection algorithms are very important technique to build a mobile robot. This study is a study on a framework for human detection methods using two LiDAR sensors both of RPLiDAR A1M8 and Intel RealSense L515, and notification to mobile devices assuming a several mobile robots. Therefore, we approach to make human detection or tracking, and notify the detection alert to the users using such detection technology and spatial distance information by using camera and two LiDAR sensors. Furthermore, we aim to establish an efficient human detection and autonomous robot movement model by using LiDAR sensors.

28PM1-1-3 Performance Evaluation of Ethereum Blockchain on Flying Ad-hoc Network

Proc. pp. 9-12

Yue Su (Chiba University), Kien Nguyen (Chiba University), Hiroo Sekiya (Chiba University)

It's essential to evaluate the latency of the IoT-Blockchain system because it affects the transactions and blocks synchronization of the blockchain. In this study, we evaluate two latency components (i.e., TOL and BOL) in a flying ad-hoc network (FANET), and the assessment results show the TOL and BOL values following different amounts of transactions.

28PM1-1-4 Experimental Demonstration of APCMA's Scalability Advantage over Current LPWA

Proc. pp. 13-16

Kohei Shiotsuka (Tokyo University of Science), Kentaro Honda (Tokyo University of Science), Kenji Leibnitz

(National Institute of Information and Communications Technology), Ferdinand Peper (National Institute of Information and Communications Technology), Naoki Wakamiya (Osaka University), Yoshihiro Maeda (Tokyo University of Science), Mikio Hasegawa (Tokyo University of Science)

In recent years, various long-range low-power communication technologies (Low-Power-Wide-Area, LPWA) suitable for IoT wireless communications have been put to practical use. However, as the traffic of IoT devices increases, packet loss due to collisions is becoming a serious problem. Therefore, Asynchronous Pulse Code Multiple Access (APCMA) has been proposed specifically for communication in high-density environments, which separates and demodulates collisions even if they occur at the receiving end. In this study, we compare the performance of LoRa and a new LPWA, Chirp Spread Spectrum (CSS)-APCMA, using 50 actual units of each. We have confirmed that when the total bit rate was 100 bit/s, the communication success probability of LoRa was about 85%, while APCMA maintained 100%. From these results we confirmed that APCMA has an advantage in communication in high-density environments.

28PM1-1-5 A Routing Method Considering Content-Server Mobility in Tree-Structured Mobile Network over CCN

Proc. pp. 17–20

Yuto Nakagawa (Tokyo University of Information Sciences), Masaki Hanada (Tokyo University of Information Sciences), Hidehiro Kanemitsu (Tokyo University of Technology)

Content-Centric Networking (CCN) has emerged as a future networking architecture for improving content distribution. The main features of CCN architecture are content caching and content-based routing. In CCN architecture, when a user requests a content, an Interest packet which is used to request the content is forwarded by each CCN router along the path toward the content-server. Subsequently, a Data packet which supplies actual data is returned by the content-server (or a CCN router which stores the requested content) along the reverse path of the Interest packet. CCN has mainly been focusing on efficient content distribution in wired networks. Therefore, the mobility support is not considered sufficiently in mobile wireless networks. The mobility support is classified as the producer (content-server) mobility and the consumer (user) mobility. In CCN, the consumer mobility is easily supported by retransmission of the Interest packet. When the consumer moved to another location (i.e., a new access point), the consumer requests the same content by the retransmission of the Interest packet. However, the producer mobility is a crucial problem since the routing table should be frequently changed. In this paper, we propose a routing method using consumer movement prediction for producer mobility support. This method is based on a periodic routing table update. In addition, the method predicts a new access

point using RSSI (Received Signal Strength Indicator) from the consumer mobile device. Then, the method updates the routing table so that the producer receives the Interest packet from both the new access point and the original access point. In experimental evaluation, we show that the proposed method improves the original CCN routing method in terms of the accuracy of content delivery.

28PM1-2: Artificial Intelligence and Machine Learning 1

Date: 28 February, 2:00pm to 3:40pm HST (1 March, 9:00am to 10:40am JST)

Room: Zoom Meeting Room2

Chair: Takafumi Tanaka (Tamagawa University)

28PM1-2-1 Influences of Dataset Divided by the Size in Sweet Potato Selection System Using Deep Learning

Proc. pp. 21–24

Nguyen Thao Nguyen (Shikoku University), Yasuteru Hosokawa (Shikoku University)

Each farmer in Tokushima selects sweet potatoes individually. The selection is completely done by hand and takes a lot of time. Moreover, only experienced people can do it well. Therefore, our team has been developing a machine that assists farmers in selecting sweet potatoes. In this study, we try to applying a new process for improving the accuracy by the reviewing the farmers selection process. The selection process of the farmer is that the first is selection by the size and the second is selection by the shape and the grade. Namely, the selection of the grade is carried out each size. Therefore, the dataset and the model for deep learning are constructed by each size. The differences of each predicted results will be important information for improving the accuracy.

28PM1-2-2 Shape Sorting by Deep Learning in Sweet Potato Selection System

Proc. pp. 25–28

Bao Duong Gia Nguyen (Shikoku University), Yasuteru Hosokawa (Shikoku University)

In this study, the shape classification by deep learning in sweet potato selection system is investigated. The accuracy of the method using only the length is about 0.83. On the other hand, The accuracy of the method using deep learning of the image is about 0.86. Although only a few percent can be improved, it is considered that better result will be obtained by tuning of the model and parameters of the learning. Now, these tuning are carried out and it will be

shown in camera-ready.

28PM1-2-3 Knowledge Distillation with Mask-based Relationship for Speech Enhancement

Proc. pp. 29–32

Jiachen Wang (Waseda University), Li Li (Nippon Telegraph and Telephone Corporation), Shoji Makino (Waseda University)

In this paper, a novel mask-based relationship knowledge is proposed for speech enhancement models in U-net architectures. The proposed method works by utilizing the ideal ratio mask (IRM) calculated through the features from the corresponding encoder and decoder as the transferred knowledge. Besides, we took the L2 loss between the IRM obtained by teacher and student model as the cost function of transferring the distilled knowledge. The result of the experiments demonstrates that the proposed method outperforms the response knowledge, which is the conventional knowledge distillation method in speech enhancement task.

28PM1-2-4 Deep Complex-Valued Neural Network-Based Triple-Path Mask and Steering Vector Estimation for Multi-channel Target Speech Separation

Proc. pp. 33–36

Mohan Qin (Waseda University), Li Li (Nippon Telegraph and Telephone Corporation), Shoji Makino (Waseda University)

This paper proposes a deep complex-valued neural network-based beamforming framework for multi-channel target speech separation. The deep complex-valued neural network predicts steering vectors and complex ratio masks for speaker signals. The masked signals are then used to calculate the spatial covariance matrices that are needed for conducting Minimum Variance Distortionless Response (MVDR) beamforming filter. We propose a Triple-path modeling for mask estimation, which takes both intra-channel and inter-channel features into consideration. Our experimental results revealed that the proposed framework achieved better target speech separation performance than the baseline methods.

28PM1-2-5 Development of CNN to Estimate Depth Distribution Spectrometry of Soil

Proc. pp. 37–40

Mohd Azam Bin Mohd Pauzi (Kagawa University), Takuto Umemoto (Kagawa University), Kenichi Fujimoto (Kagawa University), Minoru Sakama (Tokushima University), Kazumasa Inoue (Tokyo Metropolitan University), Masahiro Fukushi (Tsukuba International University), Yusuke Imajyo (Advanced Fusion Technology Co. Ltd.), Michitaka Endo

(Advanced Fusion Technology Co. Ltd.)

In our laboratory, an estimation system using a convolutional neural network (CNN) is being developed. This paper discussing about the usage of CNN to improve the accuracy of estimation depth distribution spectrometry of radiation isotope in soil layers.

28PM2-1: Nonlinear Circuits and Systems 1

Date: 28 February, 4:00pm to 6:00pm HST (1 March, 11:00am to 1:00pm JST)

Room: Zoom Meeting Room1

Chair: Tatsuki Osato (NIT, Hachinohe College)

28PM2-1-1 Safe Driving System for Electric Wheelchair with Balloon-type Pneumatic Interface

Proc. pp. 41–44

Kosei Hirano (Tokushima University), Hiroshi Suzuki (Tokushima University), Takahiro Kitajima (Tokushima University), Akinobu Kuwahara (Tokushima University), Takashi Yasuno (Tokushima University), Shinjiro Takata (Tokushima National Hospital)

In recent years, research on eye gaze input has been progressing as an interface for severely paralyzed patients with muscular dystrophy and ALS. However, gaze input is a heavy burden because it simultaneously input and output information to and from the brain using the eyes. Therefore, there is a demand for an interface that is easy to use and less burdensome even for severely paralyzed patients. In this study, we focus on the movement of the fingertips, which tend to remain the motor function compared to other body parts even in the severe paralysis. Therefore, we proposed a balloon-type pneumatic interface that can detect slight movements of the fingertip and is easy to install into contracted fingers by shrinking it. This paper proposed a driving system for an electric wheelchair using two pneumatic interfaces. Left and right pneumatic interfaces are allocated to both wheels of an electric wheelchair respectively. In addition, a collision avoidance function is installed for safe driving even for severely paralyzed patients. For collision avoidance function, environmental information is measured by a laser range finder mounted in front of the wheelchair. Validity and controllability of the proposed driving system are evaluated from maneuvering experiments.

28PM2-1-2 Data Acquisition System of Human Skillful Operation Using Master-Slave Robot Manipulator

Proc. pp. 45–48

Yuto Yamada (Tokushima University), Hiroshi Suzuki (Tokushima University), Takahiro Kitajima (Tokushima University), Akinobu Kuwahara (Tokushima University), Takashi Yasuno (Tokushima University)

In recent years, various simple tasks have been automated in industrial field with the development of robot technology. On the other hands, the automation of complex manual tasks which need higher skills by an expert in desired. However, it is difficult to realized the robot control as replicate the expert with industrial sequence control approach since any of skills of experts cannot be verbalized. Therefore, several control methods that replicate skilled tasks based on obtained operational data using data-driven control or machine learning have been proposed. In this paper, we propose a data acquisition system for a bilateral control of position and force using master-slave type robot manipulator which can measure the operation data of the human. The master manipulator is designed under considering the dimensional ratio of the slave, DOBOT Magician. Each joints of the master has potentiometer to measure the joint angle and actuator for force feedback. Each joint angle of the slave are controlled to match the master, and forces and torques in each of the three axes of the master tip are controlled based on feedback from the slave. By performing tasks via master-slave manipulator, it is possible to measure the operation skills of the human, including haptics. Proposed bilateral control is evaluated from experimental results of peg-in-hole task using the prototype master-slave type robot manipulator.

28PM2-1-3 A Novel Hybrid Wireless Power Transfer System for Battery Charging Applications

Proc. pp. 49–52

Wenqi Zhu (Chiba University), Yutaro Komiyama (Chiba University), Kien Nguyen (Chiba University), Hiroo Sekiya (Chiba University)

In this research, a novel load-independent Class-E/F inverter with CV and CC output modes is proposed. The proposed inverter can change into the class-E topology by adding one auxiliary switch to the class-E/F inverter. A components design method is proposed to achieve load-independent conditions for both topologies by merging the design conditions of the load-independent class-E and class-E/F inverters together. Therefore, the proposed inverter can switch between CV and CC output modes against load changes at the same switching frequency. Additionally, ZVS can be maintained for both modes despite load variation. The proposed inverter has a simplified topology, making it suitable for minimized wireless power transfer applications as the transmitter part. A 1 MHz experimental prototype circuit was designed and implemented. A circuit experiment was conducted, which confirmed the usefulness of the proposed inverter.

28PM2-1-4 Analysis and Design of Push-pull Load-independent Class-E Frequency Tripler

Proc. pp. 53–56

Yinchen Xie (Chiba University), Wenqi Zhu (Chiba University), Yutaro Komiyama (Chiba University), Kien Nguyen (Chiba University), Hiroo Sekiya (Chiba University)

In this study, we perform circuit analysis to achieve the load-independent condition for the class-E push-pull frequency tripler and propose a design method. Through the simulation, we confirmed that ZVS and constant output voltage could resist load variations, which verified our design method is reliable.

28PM2-1-5 Optimization of Shape of PSI for Rotation Angle Measurement System with Three PSIs

Proc. pp. 57–60

Ryota Masumoto (Hiroshima Institute of Technology), Keito Ohshita (Hiroshima Institute of Technology), Masayuki Yamauchi (Hiroshima Institute of Technology)

We have been developing a rotation angle measurement system with Printed Spiral Inductors (PSIs). This system measures a rotation angle by changing mutual inductance between PSIs by rotating one of the PSIs. It is desired that a combined impedance of this sensor changes as V-shape in rotating 360 degrees. However, the combined impedance changed as U-shape in our previous study. Therefore, it was hard to measure around 180 degrees. In this paper, we investigate connecting method among three PSIs and suitable shape of PSIs so that the combined impedance changes as V-shape in rotating.

28PM2-1-6 Study on Precision Recall by Using van der Pol Oscillators with Third-Power and Fifth-Power for Associative Memory

Proc. pp. 61–64

Yukinojo Kotani (Tokushima University), Kento Fukuta (Tokushima University), Yoko Uwate (Tokushima University), Yoshifumi Nishio (Tokushima University)

Synchronization phenomenon is that two or more objects do the same motions at the same time. It is observed in nature, such as firefly' luminescence, creature' heartbeat, frog's cry and so on. In electrical engineering, this phenomenon is also observed on the coupling oscillator. Associative memory is particular to human ability, so it is superior to computer. On the other hand, some people cannot recognize the names and emotions when they see human' faces without age relationship. This illness is called prosopagnosia. To assist the patients, we need to improve associative memory function of computer for development of medical appliances. Hence,

associative memory was studied by using oscillators array. In addition, associative memory was realized on the coupling circuit model of van der Pol oscillators with third-power. However, the nonlinear resistor in van der Pol oscillator has other types of the current-voltage characteristics. We focus on the difference of the current-voltage characteristics. In this study, we compared the response speed of recall and accuracy by using the 10x6 coupling circuit models of van der Pol oscillators with third-power and fifth-power. As a result, we confirmed that the recall response of the circuit model with fifth-power was faster than with third-power regardless of input patterns. After that, we calculated the average value of recall rate for each coupling circuit. By comparison, the average value of recall rate of the circuit model with fifth-power was higher than with third-power.

28PM2-2: Artificial Intelligence and Machine Learning 2

Date: 28 February, 4:00pm to 6:00pm HST (1 March, 11:00am to 1:00pm JST)

Room: Zoom Meeting Room2

Chair: Yihsin Ho (Takushoku University)

28PM2-2-1 Growth stage estimation of cabbage plants by deep learning

Proc. pp. 65–65

Jonggeol Park (Tokyo University of Information Sciences), Jiu Yun Zhang (Tokyo University of Information Sciences)

With the rapid development of the drone industry in recent years, drone technology is widely used in the field of agriculture. Drone remote sensing can provide high-resolution images in a small area at a low cost. Observation is possible at any time if there is no wind or rain. Therefore, it is often used for vegetation observation in smart agriculture. Cabbage is one of the vegetables with a wide planted area and a large scale of management [1]. However, since cabbage is a labor-intensive crop, labor saving in harvesting is essential. Even if cabbage seeds are sown on the same day, the growth of each plant differs depending on the growing environment, resulting in different shipment dates. Therefore, when the harvest season comes, it is difficult to harvest all at once using a machine, and manual harvesting is common. In order to harvest by machine, it is necessary to automatically determine the growth stage of the crop for each strain. In this study, the growth stage estimation of cabbage is performed using an object detection method based on machine learning. There are two methods for estimating the growth stage: 1. Detection of each growth stage of cabbage by YOLOv52. After extraction of cabbage candidate regions by YOLOv5,

individual growth stage estimation by ResNet is compared.

28PM2-2-2 Combined Use of Federated Learning and Image Encryption for Privacy-Preserving Image Classification with Vision Transformer

Proc. pp. 66–69

Teru Nagamori (Tokyo Metropolitan University), Hitoshi Kiya (Tokyo Metropolitan University)

In recent years, privacy-preserving methods for deep learning have become an urgent problem. Accordingly, we propose the combined use of federated learning (FL) and encrypted images for privacy-preserving image classification under the use of the vision transformer (ViT). The proposed method allows us not only to train models over multiple participants without directly sharing their raw data but to also protect the privacy of test (query) images for the first time. In addition, it can also maintain the same accuracy as normally trained models. In an experiment, the proposed method was demonstrated to well work without any performance degradation on the CIFAR-10 and CIFAR-100 datasets.

28PM2-2-3 A Privacy Preserving Method with a Random Orthogonal Matrix for ConvMixer Models

Proc. pp. 70–73

Rei Aso (Tokyo Metropolitan University), Tatsuya Chuman (Tokyo Metropolitan University), Hitoshi Kiya (Tokyo Metropolitan University)

In this paper, a privacy preserving image classification method is proposed under the use of ConvMixer models. To protect the visual information of test images, a test image is divided into blocks, and then every block is encrypted by using a random orthogonal matrix, respectively. Moreover, a ConvMixer model trained with plain images is transformed by the random orthogonal matrix generated from the random matrix used for encrypting test images, on the basis of the embedding structure of ConvMixer. The proposed method allows us not only to use the same classification accuracy as that of ConvMixer models without considering privacy protection but to also enhance robustness against various attacks compared to conventional privacy-preserving learning.

28PM2-2-4 Color-NeuraCrypt: Privacy-Preserving Color-Image Classification Using Extended Random Neural Networks

Proc. pp. 74–77

Zheng Qi (Tokyo Metropolitan University), AprilPyone MaungMaung (Tokyo Metropolitan University), Hitoshi Kiya (Tokyo Metropolitan University)

In recent years, with the development of cloud computing

platforms, privacy-preserving methods for deep learning have become an urgent problem. NeuraCrypt is a private random neural network for privacy-preserving that allows data owners to encrypt the medical data before the data uploading, and data owners can train and then test their models in a cloud server with the encrypted data directly. However, we point out that the performance of NeuraCrypt is heavily degraded when using color images. In this paper, we propose a Color-NeuraCrypt to solve this problem. Experiment results show that our proposed Color-NeuraCrypt can achieve a better classification accuracy than the original one and other privacy-preserving methods.

28PM2-2-5 Color Image Demosaicking via SwinIR

Proc. pp. 78–81

Ai Tsuchihashi (Tamagawa University), Daiki Arai (Tamagawa University), Taishi Iriyama (Saitama University), Masatoshi Sato (Tamagawa University), Hisashi Aomori (Chukyo University), Tsuyoshi Otake (Tamagawa University)

The demosaicking process is an image reconstruction process that restores a full-color image from color filter array (CFA) data. Recently, a demosaicking method based on convolutional neural network (CNN) has been investigated and has demonstrated state-of-the-art accuracy. On the other hand, Transformer-based models used in the field of natural language processing have demonstrated high performance in various image processing tasks. In this paper, we propose a novel demosaicking method for Bayer CFA, using SwinIR which is one of the Transformer-based models. Experimental results show that the proposed method provides better or competitive results compared to several state-of-the-art deep CNN-based demosaicking algorithms.

28PM2-2-6 Bit Depth Expansion Network Considering Layer Attention

Proc. pp. 82–85

Noriya Kondoh (Tamagawa University), Daiki Arai (Tamagawa University), Taishi Iriyama (Saitama University), Masatoshi Sato (Tamagawa University), Hisashi Aomori (Chukyo University), Tsuyosi Otake (Tamagawa University)

Bit depth of an image is the number of bits that represents the luminance value of each RGB color channel of an image pixel. In this paper, we propose a novel bit-depth expansion method that introduces a layer-attention structure into the encoder-decoder model. A novel layer attention module is implemented to use the attentions among the feature maps of each layer. Experiments are conducted with WED and Kodak as training and test datasets, respectively. The proposed method performed as well as or better than state-of-the-art CNN-based bit-depth enhancement algorithms.

28PM2-3: Signal Processing

Date: 28 February, 4:00pm to 6:00pm HST (1 March, 11:00am to 1:00pm JST)

Room: Zoom Meeting Room3

Chair: Xiuqin Wei (Chiba Institute of Technology)

28PM2-3-1 Initial research developing equipment for multimodal analysis to evaluate swallowing function

Proc. pp. 86–89

Yujiro Sawanobori (University of Yamanashi), Yutaka Suzuki (Toyo University), Masayuki Morisawa (University of Yamanashi)

Pneumonia is the fourth leading cause of death in Japan's super-aged society, and many of these deaths are associated with aspiration pneumonia. These people with low swallowing function need to know which swallowing job is appropriate for their own swallowing ability. Non-invasive, quantitative methods to assess swallowing have been studied using pharyngeal ultrasound videos, surface electromyography, and swallowing sounds. However, each of these signals has a limited temporal and spatial range of swallowing movements that can be measured. In this study, we constructed a novel system to simultaneously record all three signal types and compare them on the same time axis, and discussed detailed swallowing movements based on the information obtained from each signal. In the future, we will consider the automatic detection of these events.

28PM2-3-2 Classification of Ripple Waves into Experienced Episodes Using CNN

Proc. pp. 90–93

Yuta Ishihara (Kagawa University), Ken'ichi Fujimoto (Kagawa University), Hiroshi Murai (Yamaguchi University), Junko Ishikawa (Yamaguchi University), Dai Mitsushima (Yamaguchi University)

The hippocampus plays an important role to memorize episode experience. In a previous study, some of the author indicated that emotional episodes increase the number of ripple waves in multiple-unit activity (MUA) at hippocampal CA1 neurons. From the fact, we assume that the waveform of ripples can dynamically changes before and after episode experience; the waveform also depends on the kind of experienced episodes. Our goal is to find typical waveforms, which corresponds to experienced episodes, embedded in ripples. As preliminary study, we found similar ripple waves in each episode experience using our method based on standardization, logarithmical transform, and cross-correlation function. In this paper, we consider whether convolutional neural network (CNN) can classify the similar ripple waves into each episode. If the CNN can classify them correctly, one can say that a certain waveform related to each episode is embedded in ripples waves.

28PM2-3-3 Real-time Moving Blind Source Extraction based on Constant Separating Vector and Auxiliary Function Technique

Proc. pp. 94–97

Sihan Yuan (Waseda University), Tetsuya Ueda (Waseda University), Shoji Makino (Waseda University)

In this paper, we proposed a novel online algorithm for moving blind source extraction. The baseline algorithm based on the recently proposed constant separating vector (CSV) mixing model with auxiliary-function-based independent vector extraction (AuxIVE), is an offline algorithm, which is not suitable for some devices that require real-time processing. In this case, the proposed algorithm only needs to know the partially mixed signal and then process the observed signal in a sequential manner. The experiment compared the proposed algorithm with the conventional blind method (online AuxIVA), and the results confirm that the average SDR of online CSV-AuxIVE is approximately 1.5 dB higher than that of online AuxIVA under the same conditions of the target source, regardless of the change in the speed and range of the interference.

28PM2-3-4 Generation-based entity typing in knowledge graphs using a pretrained model

Proc. pp. 98–101

Kosuke Aigo (Shizuoka University), Takashi Takashi (Shizuoka University), Masafumi Nishida (Shizuoka University), Masafumi Nishimura (Shizuoka University)

Entity typing means assigning types (e.g., a person, organization, object type, or concept about which information is stored) to entity mentions. For example, the entity of "Michael Jackson," who is a famous artist, has the types of "/music/artist" and "/film/actor" in the knowledge base FB15kET dataset. This type of entity-type could provide useful clues for relationship extraction, entity linking, and question answering. Previous studies have treated entity typing as a classification task because entity types are predefined as a set of terms or a hierarchy. One disadvantage of this approach is that it is difficult to assign infrequent/unobserved types in the training data. Another is that it uses a fixed set of entity types. Similar to entities in knowledge bases, entity types should vary according to changes in the knowledge. To address these issues, we propose a method for generating entity types instead of classifying entity types in knowledge graphs. And we showed that generative models can generate for the unobserved (unknown) types by comparing Observed and Unobserved results.

28PM2-3-5 Combination of Binary and Ratio Masks

with Frequency Domain Subband Division for DNN-based Single-Channel Speech Separation

Proc. pp. 102–105

Peng Chen (Ritsumeikan University), Yuting Geng (Ritsumeikan University), Kenta Iwai (Ritsumeikan University), Takano Nishiura (Ritsumeikan University)

In supervised single-channel speech separation, time-frequency mask is an important aspect to separate speech signals with high accuracy. For a long time, ideal binary mask (IBM) and ideal ratio mask (IRM) have been widely used to separate the speech signals. In general, the IBM can improve speech intelligibility, and the IRM can improve speech quality. Also, the spectral structures of each speaker differ from others according to frequency domain subband division. Based on the above considerations, in this paper, we propose a new speech separation method combining different masks with division of the frequency band. This will help to optimize the value of the training target, so as to improve the intelligibility and quality of separated speech signals. The objective evaluation experiment and evaluation indicators prove the effectiveness of our proposed method.

28PM2-3-6 Flower Group Detection for Cherry Tomato Fruiting Treatment Robot Using Depth Camera

Proc. pp. 106–109

Jun Shimazaki (Tokushima University), Hiroshi Suzuki (Tokushima University), Takahiro Kitajima (Tokushima University), Akinobu Kuwahara (Tokushima University), Takashi Yasuno (Tokushima University)

In recent years, Japanese agriculture is facing the problems of decreasing in the number of farmers and an increasing in the average age of farmers, and there is a need to save labor and improve productivity. Therefore, research and development of smart agriculture using robot technology and ICT are underway. In this study, we focused on the fruiting treatment task of tomatoes, for which most of the production is accounted by facility horticulture. Fruiting treatment is necessary in tomato facility horticulture because natural pollination cannot be expected. Automation of fruiting treatment in tomato cultivation is expected to save labor and improve harvest efficiency through uniform fruiting. In this paper, we proposed a flower group detection algorithm for cherry tomato that detects flowers and clusters them based on distance between flowers. Flowers were recognized by image processing of distance data acquired by the depth camera. The position of the flower groups is calculated as the center coordinates of flower groups. The recognition accuracy of the proposed algorithm is evaluated from several experimental results in a greenhouse of cherry tomatoes.

28PM3-1: Wireless Communication Systems 2

Date: 28 February, 7:00pm to 9:00pm HST (1 March, 2:00pm to 4:00pm JST)

Room: Zoom Meeting Room1

Chair: Yue Su (Chiba University)

28PM3-1-1 Programming Learning Support System using Digital Textbook and Exercise Management Systems

Proc. pp. 110–113

Hatsune Ochiai (Tamagawa University), Takafumi Tanaka (Tamagawa University)

In general, programming fundamentals at universities consist of lectures and exercises. To solve the exercises, learners with low levels of understanding should review their weak learning items to use in the exercises before tackling them. However, they often cannot determine the items should be reviewed by themselves. In addition, it is often difficult for the learners to extract learning items necessary to solve the exercises. On the other hand, learners often stumble and lose motivation if an exercise was more 'difficult' than they thought. The personal 'difficulty' depends on not only the complexity of the program, numbers of learning items to use, and so on but also the learners' state for learning. In this paper, 'State for learning' means a learner's state for understanding, state for progress of other exercises, and the learner's learning styles. Thus, it is difficult to establish a unified standard of the 'difficulty' of the exercises. Therefore, this study proposes the following two solutions to the problems. (1) Determining and presenting the learning items which should be reviewed for the individual learners considering their states of learning. (2) Determining and presenting 'difficulty' of an exercise for the individual learners based on considering their states of learning. We realize the solutions by analyzing learner's logs of knowledge learning and exercise learning. We collect learners' reading logs from a digital textbook system as data of knowledge learning. We also collect their logs from an exercise management system as data of exercise learning. In this paper, we describe a learning method including our solutions and the development of the prototypes of support systems for the method.

28PM3-1-2 A Characteristic Analysis of GLDM in Introduction Scheme of Next-Generation DTTB

Proc. pp. 114–117

Masashi Sekiguchi (Kanagawa University), Takashi Komatsu (Kanagawa University), Akira Nakamura (Kanagawa University), Makoto Itami (Tokyo University of Science)

Introduction scheme of next-generation digital terrestrial television broadcasting(DTTB) is considered for 4K broad-

casting using same channel as existing 2K broadcasting. The layered division multiplexing(LDM) scheme is adopted to introduction scheme of next-generation DTTB. Sequential decoding and direct decoding are proposed as decoding method of LDM. And gray mapped LDM(GLDM) is also proposed to improve reception performance of direct decoding. However, sequential decoding and direct decoding have not yet compared in introduction scheme of next-generation DTTB. And characteristic of direct decoding using non-uniform constellation(NUC) for modulation scheme of LL has not yet studied. In this paper, the characteristics of sequential decoding and direct decoding in introduction scheme of next-generation DTTB are evaluated by computer simulation. Both uniform constellation(UC) and NUC is used in this simulation. In the result of simulation, direct decoding is better than sequential decoding when serious multipath environment. In the other hand, sequential decoding is better in case high injection level(IL). Especially, NUC is adopted as modulation scheme of LL.

28PM3-1-3 A Study on Multi-Stream Transmission Using Generalized Imperfect Block Diagonalization for MU-MIMO Downlink

Proc. pp. 118–121

Tadatomo Sato (NIT Kagoshima College), Teruji Ide (NIT Kagoshima College)

In this paper, we focus on linear precoding techniques that provide multi-stream transmission to all users in a multi-user MIMO downlink, and propose a multi-stream GIBD precoding. In the proposed method, the cost function used in the convergence algorithm to find the optimal coefficient vector is defined by determinants and cofactors, so that the update equation is not complicated by the number of users or streams. In addition, the average BER of single-stream transmission and multi-stream transmission are evaluated by computer simulation.

28PM3-1-4 Adaptive Zero Hybrid Guard Interval for Multiuser Diversity DFTs-OFDMA

Proc. pp. 122–125

Kojiro Nakano (Yamaguchi University), Yuta Ida (Yamaguchi University), Takahiro Matumoto (Kagoshima University)

In an orthogonal frequency division multiple access (OFDMA), the system performance is improved with the multiuser diversity (MUDiv) gain. Moreover, OFDMA is mitigated for the deterioration due to a deep faded channel by using the discrete Fourier transform spreading (DFTs). In this system, inter-symbol interference (ISI) due to a multipath are prevented by inserting the guard interval (GI). However, since GI is the redundancy signal, the transmission power is enhanced. In this paper, we propose the zero hybrid

GI based on the channel state of the MUDiv and the threshold for a MUDiv-DFTs-OFDMA.

28PM3-1-5 Deep Learning Compensation for Multiuser Diversity OFDMA without Guard Interval

Proc. pp. 126–129

Shunsuke Tsumori (Yamaguchi University), Yuta Ida (Yamaguchi University), Sho Kuroda (FX Systems Corporation), Takahiro Matsumoto (Kagoshima University)

In an orthogonal frequency division multiple access (OFDMA), the system performance is improved with the multiuser diversity (MUDiv) gain. In this system, inter-symbol interference (ISI) and inter-carrier interference (ICI) due to a multipath are prevented by inserting the guard interval (GI). However, this operation is deteriorated for the transmission rate. This deterioration is compensated by the deep learning, but it is utilized for the known ISI and the ICI information. In this paper, we propose the deep learning compensation with the estimated ISI and the ICI for a MUDiv-OFDMA without the GI.

28PM3-1-6 A Preliminary Evaluation of Millimeter-Wave Communications for Information-Centric Wireless Sensor Networks

Proc. pp. 130–130

Shintaro Mori (Fukuoka University)

This paper presents an information-centric wireless sensor network-based ecosystem for smart-city applications and investigates their applicability to millimeter-wave wireless communication. The test devices are developed as a portable unit to be able to carry out in the on-site field condition. The experiments are conducted through indoor and outdoor environment using Terragraph that is specified based on IEEE 802.11 ad/ay standard.

28PM3-2: Artificial Intelligence and Machine Learning 3

Date: 28 February, 7:00pm to 9:00pm HST (1 March, 2:00pm to 4:00pm JST)

Room: Zoom Meeting Room2

Chair: Yasuteru Hosokawa (Shikoku University)

28PM3-2-1 An Application for Searching Sheep based on Machine Learning by Drone

Proc. pp. 131–133

Chengyuan Dong (Takushoku University), Yihsin Ho (Takushoku University)

With the industrialization of society, our life is getting better and better. The animal husbandry is one of the important factors that constitute the human's social structure. There are still many companies that rely on animal husbandry to make a fortune. Sheep is a representative of animal husbandry. People can eat its meat, use its fur to make our winter clothing, and its bones to make pet food. All in all, sheep have higher profits to a farm/company, therefore, losing a sheep is quite cost for a small farm/companies. In this paper, we consider using the drones to help a farm search sheep. The drone captures images and videos of sheep, and these images and videos process by image processing and machine learning. The presented method is target to help effety and quickly find stray sheep.

28PM3-2-2 Behavior Recognition and Monitoring System for Office Workers by Deep Learning from Two Surveillance Cameras

Proc. pp. 134–137

Atsushi Ogino (Konan University), Masahiro Tanaka (Konan University)

The objective of this paper is to construct a system that recognizes the behaviors of office workers. Our system contributes to improving the work attitude of workers and preventing overwork. Our system integrates several deep learning algorithms to recognize behaviors of individuals from two surveillance cameras. This paper describes a behavior recognition system using the object detection algorithm YOLOv5 and the object tracking algorithm DeepSORT and a personal identification method between two cameras. Furthermore, we describe the experimental results of our system in a university laboratory.

28PM3-2-3 Determining cavities in fresh concrete using sparse estimation and self-organizing maps

Proc. pp. 138–141

Kota Takane (University of Yamanashi), Shion Ikeda (University of Yamanashi), Masayuki Morisawa (University of Yamanashi), Yutaka Suzuki (Toyo University)

Skilled workers empirically determine voids during concrete pouring by tapping the formwork with a hammer and listening to the sound generated. In this study, we present a void visualization system using a self-organizing map (SOM) generated from percussion sounds. In addition, sparse modeling using the Lasso regression technique is used to compress the feature vector to approximately 2.5 % for training. Three initial node patterns are used in the SOM for training: random values, principal component analysis, and

fixed nodes. In the cases where the initial values are random or determined via principal component analysis, the data are grouped into classes. However, this requires some skill in map reading because data with similar properties are not placed close to each other. Conversely, in the cases of initial node fixation, users can read the map with the characteristics of a SOM. Therefore, the fixed-node pattern results in a highly readable map.

28PM3-2-4 Reservoir Computing using Cellular Automata for Predicting Time Series

Proc. pp. 142–145

Riku Tooyama (Nagaoka University of Technology), Tadashi Tsubone (Nagaoka University of Technology)

An effective machine learning architecture called "reservoir computing" is attracting attention these years because of their low limitation of structures and the possibility to realize more light-weight, efficient models. In our research, we provide a reservoir using the dynamics called cellular automata(CA). that generates complex patterns even though this only has binary value and is governed by simple rule. Previous study showed the reservoir composed of CA has an ability to memory and predict bit sequence. In this paper, we aimed to handle continuous values with CA and tried to predict some discrete chaos dynamics as an evaluation task. Through optimizing reservoir parameters such as CA Rules, we found proposed method can predict these values and has a unique character caused by its state is binary.

28PM3-2-5 Estimation of Temperature and Humidity Spatial Distribution in Horticultural Greenhouses Using Machine Learning

Proc. pp. 146–149

Sonoka Yamashita (Tokushima University), Hiroshi Suzuki (Tokushima University), Takahiro Kitajima (Tokushima University), Akinobu Kuwahara (Tokushima University), Takashi Yasuno (Tokushima University)

The introduction of greenhouse horticulture in Japan is increasing in order to improve labor productivity. In the greenhouse horticulture, it is expected to ensure productivity and stable supply throughout the year by controlling the environments such as temperature, humidity, irrigation and CO₂. In our laboratory, an environmental control system for greenhouse is developing and cultivates tomato among horticultural facilities. The developed system is designed based on the idea that controlling of temperature and humidity uniformly will enable a stable supply of crops throughout the year. Therefore, many of sensors in the greenhouses are installed to measure detailed trends of temperature and humidity. This paper describes a method for estimating the spatial distribution of temperature and humidity from several representative sensors, and the optimal combination of

sensor locations and the number of sensors to achieve highly accurate estimation. The spatial distribution of temperature and humidity was estimated from measured values of some representative points using an estimation model which consists of a multilayer perceptron, and the estimated result was evaluated from the error and correlation between the measured value.

28PM3-2-6 Prediction Model of Wind Speed and Direction Using CNN and CLSTM with Vector Images Input

Proc. pp. 150–153

Hiroto Kanagawa (Tokushima University), Hiroshi Suzuki (Tokushima University), Takahiro Kitajima (Tokushima University), Akinobu Kuwahara (Tokushima University), Takashi Yasuno (Tokushima University)

This paper describes a wind speed prediction method using wind vector images as input to a neural network. A prediction model combines a convolutional neural network (CNN) and a convolutional long short-term memory (CLSTM), which are effective for image analysis. Several input image data structure expressing wind vector change are considered and compared the prediction accuracy between them. The performances of the proposed method is evaluated by the root-mean-square error and correlation coefficient between observed and predicted values.

1AM1-1: Nonlinear Circuits and Systems 2

Date: 1 March, 9:00am to 10:20am

Room: PLUMERIA

Chair: Takayuki Kimura (Nippon Institute of Technology)

1AM1-1-1 Synchronization of Bi-Directionally Coupled Chaotic Circuits with Non-Uniform Coupling Strength

Proc. pp. 154–157

Yuki Matsubara (Tokushima University), Yuki Ishikawa (Tokushima University), Yoko Uwate (Tokushima University), Yoshifumi Nishio (Tokushima University)

In this study, we investigate the synchronization of bi-directionally coupled chaotic circuits with non-uniform coupling strength in proposed model. First, computer simulation of two chaotic circuits is performed. Then, the number of circuits is increased to see how it affects the synchronization phenomena. As a result, synchronization phenomena are also observed when the coupling strength is non-uniform. The number of circuits that are synchronized is related to the coupling strength that can keep the synchro-

nization phenomena.

1AM1-1-2 Chimera States in a Two-Group Networks of Kuramoto model

Proc. pp. 158–161

Toru Kumagawa (Tokushima University), Yoko Uwte (Tokushima University), Yoshifumi Nishio (Tokushima University)

Synchronization phenomena can be seen in many aspects of our daily life and has applications in a variety of fields, such as pacemakers and telecommunications. In recent years, chimera states, where synchronous and asynchronous phenomena are mixed, have attracted much attention. The oscillators are phase-locked when synchronous, and incoherent when asynchronous. In this study, we proposed a network of oscillators divided into two groups and coupled only in one part. We observe the time variation of the synchronization rate in each group in this network and phase distribution of the oscillator. As a result, it was found that the oscillator oscillates in two parts, a synchronized part and an asynchronous part, and Chimera states was observed.

1AM1-1-3 An Easy-to-Use Design Approach of Class-E-D WPT System

Proc. pp. 162–165

Hiroki Kagawa (Chiba Institute of Technology), Takuya Iwami (Chiba Institute of Technology), Yota Matui (Chiba Institute of Technology), Wei Xiuqin (Chiba Institute of Technology)

In this paper, a wireless power transfer (WPT) system which is composed of a class-E inverter as the driver and a class-D rectifier as the receiver is focused on. Besides, an easy-to-use analysis-based design procedure for the class-E-D WPT system is presented. By using the proposed design procedure, it is possible to derive accurate design values which can allow the class-E zero-voltage-switching/zero-derivative-switching (ZVS/ZDS) to be obtained. Additionally, it provides physical insights into the operations of the WPT system for designers. The validity of the design procedure given in this paper is demonstrated by LTspice simulation and circuit experiment. In the experiment, 82.9% power-transmission efficiency is obtained under 6.73W output power and 1MHz operating frequency.

1AM1-1-4 Power Losses and efficiency of Class-E-D WPT System at Any Output Voltage

Proc. pp. 166–169

Takuya Iwami (Chiba Institute of Technology), Hiroki Kagawa (Chiba Institute of Technology), Xiuqin Wei (Chiba Institute of Technology)

This paper presents an analysis of the effect of the output voltage on power loss and efficiency of the class-E-D WPT system. Conduction loss in each component of the WPT system is analyzed. Five class-E-D WPT systems with five different levels of output voltages are designed and tested. Simulated and measured results match the calculated power loss and efficiency well.

1AM1-2: Artificial Intelligence and Machine Learning 4

Date: 1 March, 9:00am to 10:40am

Room: PAKALANA & ANTHURIUM

Chair: Kenichi Shibata (RIKEN AIP)

1AM1-2-1 Prediction Model of Solar Radiation Based on Weather Forecast and MSM-GPV Using Deep Neural Network

Proc. pp. 170–173

Tomohiro Aoki (Tokushima University), Hiroshi Suzuki (Tokushima University), Takahiro Kitajima (Tokushima University), Akinobu Kuwahara (Tokushima University), Takashi Yasuno (Tokushima University)

In this paper, we propose a solar radiation prediction model based on weather forecast and numerical weather prediction data, which is called meso scale model grid point value (MSM-GPV) using deep neural network (DNN). To improve the prediction accuracy, we focus on a training method of the prediction model. Two types of input dataset for learning methods are considered: one using weather forecasts and the other using observed weather. The performances of the training methods are evaluated based on root mean square error between the predicted and observed solar radiation. As a result, it is confirmed that the prediction accuracy is improved by using the observed weather in the training process.

1AM1-2-2 Image classification with SVM for CMOS sensor generating a vector image

Proc. pp. 174–177

Haruto Oki (Ritsumeikan University), Kota Yoshida (Ritsumeikan University), Shunsuke Okura (Ritsumeikan University)

In the coming Internet of Things (IoT) era, it is important to reduce the volume of data being output by sensors as well as their power consumption. Since conventional image sensor output data for photography are often redundant in AI applications, image sensors that can output lightweight data for use in AI are needed. In this work, we propose a CMOS

image sensor (CIS) pixel circuit that can extract intensity gradients without the use of analog memories. The gradients are available for HoG features that can reduce the amount of data used in image classification. We performed experiments that evaluated whether the HoG features calculated by the outputs from our image sensor pixels were suitable for image classification tasks. We performed experiments that trained a support vector machine (SVM) classifier by simulated sensor outputs and evaluated its accuracy. We also evaluated the accuracy when of each sensor output when they were quantized using "low bit decimation" and "value clipping" to reduce the amount of data. Our experimental results indicated that the best accuracy of 99.55% was achieved with the 2-bit-width quantized gradients by value clipping and HoG features calculated with 4 x 4 cells.

1AM1-2-3 Tackling Over-smoothing on Temporal Convolutional Networks for Operating Work Segmentation

Proc. pp. 178–181

Keisuke Nakamura (Shizuoka University), Yoshitaka Yamamoto (Shizuoka University), Masafumi Nishimura (Shizuoka University), Yuki Shiono (Yamaha Motor Co. Ltd.), Reiki Shirasawa (Yamaha Motor Co. Ltd.), Takayuki Nakano (Yamaha Motor Co. Ltd.), Takahiro Aoki (Shizuoka University and Yamaha Motor Co. Ltd.)

This work investigated a (supervised) deep learning model for the automatic segmentation of manufacturing video data into a sequence of assembly operations. In the action segmentation for general human behavior, various temporal convolutional network (TCN)-based methods have been intensively proposed and demonstrated stable performance using temporal features by capturing extensive fields of image frames. However, they often make it difficult to detect unusual actions occurring in short durations, such as skipping assembly operations. In this paper, we aim at tackling this drawback by introducing the attention mechanism into the TCN model. Then, we empirically show the performance of several attention-based TCN variations using a benchmark for operational action segmentation. In addition, we present a preliminary result on the irregular detection task with naive data augmentation.

1AM1-2-4 High-accuracy reading technology for QR codes embedded in 3D printed object using an autoencoder

Proc. pp. 182–185

Hideyuki Torii (Kanagawa Institute of Technology), Masahiro Suzuki (Seisen University), Kazutake Uehira (Kanagawa Institute of Technology)

This paper presents a novel technique for accurately reading QR codes embedded in 3D printed objects using an autoencoder which is a kind of generative type deep learning. From

the simulations, we clarified the following. (1) If the QR code is embedded at a depth of up to 3 mm from the surface, the QR code can be read as it is without autoencoder in the captured image. However, it is completely unrecognizable at a depth of 7 mm (2) An image of a QR code with a depth of 7 mm can be recognized with 100% accuracy by using an autoencoder, even if the image has a large degree of blur. (3) QR codes generated with characters other than the specified characters "KAIT" are not recognized at all regardless of the embedding depth From the results of this research, the effectiveness of applying the autoencoder was confirmed.

1AM1-2-5 Non-profiled DL-SCA using Clustering on Latent Variables of Autoencoder: AE-SCA

Proc. pp. 186–189

Kunihiro Kuroda (Ritsumeikan University), Yuta Fukuda (Ritsumeikan University), Kota Yoshida (Ritsumeikan University), Takeshi Fujino (Ritsumeikan University)

There has been growing interest in side-channel attacks (SCAs), which reveal the secret key on cryptographic devices by analyzing physical information leakages such as the power consumption. Deep-learning SCAs (DL-SCAs), which apply deep neural networks (DNNs) in the profiled phase, are introduced, and demonstrate successful performance to reveal the secret key on cryptographic devices with SCA countermeasures. While there have been many studies on profiled DL-SCAs, The non-profiled DL-SCA called differential deep-learning analysis (DDLA) was proposed in 2019. In DDLA, the attacker trains DNN classifiers corresponding to all key candidates byte by byte. Therefore, when attacking against 128-bit AES encryption, it is necessary to train 16 x 256 DNN classifiers, so the DDLA requires high computational resources. In this paper, we propose AE-SCA, a new non-profiled DL-SCA that can reveal the secret key by training only one autoencoder (AE). In the proposed method, the attacker observes the distribution of the latent variables of the AE clustered in accordance with the intermediate value computed from the key candidate and plaintexts. The key candidate that contributes the best clustering is assumed to be the correct key. In the experiment, we attacked software implemented AES without SCA countermeasures. We report that the time and the number of waveforms required to reveal the secret key were reduced to about 1/250 and 1/2.5, respectively, compared to DDLA.

1AM2-1: Nonlinear Circuits and Systems 3

Date: 1 March, 11:00am to 12:20pm

Room: PLUMERIA

Chair: Hideyuki Kato (Oita University)

1AM2-1-1 Design of Load-Independent Class-EF Inverter with Nonsinusoidal Output Current

Proc. pp. 190–193

Aoi Noda (*Chiba Institute of Technology*), Yota Matsui (*Chiba Institute of Technology*), Weisen Luo (*Chiba Institute of Technology*), Xiuqin Wei (*Chiba Institute of Technology*)

This paper presents a novel design approach for the load-independent class-EF inverter with nonsinusoidal output current. By using the proposed design method, it is possible to obtain design values that achieve the Zero-Voltage-Switching (ZVS) and the constant-output-current even the output current involves a variety of harmonic contents. A design example of the load-independent class-EF inverter with nonsinusoidal output current is given with LTspice simulations and circuit experiments to illustrate that the proposed approach is effective. The ZVS and the constant-output-current are achieved even the load resistance changes, and LTspice simulations and experimental results are in good agreement with the numerical predictions that show the effectiveness of the proposed design approach.

1AM2-1-2 Wireless Power Transfer System with Series Resonant Inverse Class-E Inverter

Proc. pp. 194–197

Yutaro Komiyama (*Chiba University*), Wenqi Zhu (*Chiba University*), Xiuqin Wei (*Chiba Institute of Technology*), Kien Nguyen (*Chiba University*), Hiroo Sekiya (*Chiba University*)

This paper proposes the wireless power transfer (WPT) system with the series resonant inverse class-E inverter. The proposed WTP system mitigates the switch-voltage stress in the inverter part by achieving the zero-current switching (ZCS) instead of the zero-voltage switching (ZVS). The design procedure for the proposed WPT system is described. The circuit optimization is applied to the proposed system for obtaining maximum efficiency. Based on the design and optimization, the prototype of the proposed WPT system was implemented. The implemented system achieved 84.5 efficiency with 42 W output power at 1 MHz.

1AM2-1-3 Synchronization Phenomena in Complex Oscillatory Networks with Switching Coupling

Proc. pp. 198–201

Haruka Sakohira (*Tokushima University*), Kiichi Yamashita (*Tokushima University*), Yoko Uwate (*Tokushima University*), Yoshifumi Nishio (*Tokushima University*)

Complex networks, which are related to real-world networks, have attracted much attention and have been studied in various fields. The complex networks have common

characteristics and have been studied in terms of network topology and interactions between nodes. Complex networks with circuits have been studied, and synchronization phenomena between circuits have been confirmed. In this study, a random network is constructed using 100 van der Pol oscillators. Then the synchronization phenomena between the circuits of the network are analyzed. The computer simulations are conducted by focusing on the synchronization rate and thereby changing the topology. As a result, it is confirmed that the synchronization rate decreases by changing the topology.

1AM2-1-4 Synchronization of Chaos Networks by Changing Circuit Layout Distribution

Proc. pp. 202–205

Yoko Uwate (*Tokushima University*), Yoshifumi Nishio (*Tokushima University*)

Our research group has proposed a clustering method using synchronization of chaotic circuit networks. As an advanced version of this method, we have proposed a method that enables more difficult clustering in which the coupling between chaotic circuits varies with the synchronization rate, and we have confirmed the effectiveness of this method. By using computer simulations, we confirmed the effectiveness of the clustering accuracy of the proposed method. A discussion of the results shows that when the circuit arrangement is generated to follow a Gaussian distribution, the clustering accuracy depends on the parameters of the Gaussian distribution. In this study, we investigate the synchronization rate of chaotic circuits for different parameters of the Gaussian distribution of the circuit arrangement when one clustering is used. We analyze the effectiveness of the proposed clustering by chaotic circuit network for any circuit arrangement.

1AM2-2: Sound and Speech Processing

Date: 1 March, 11:00am to 1:00pm

Room: PAKALANA & ANTHURIUM

Chair: Nozomiko Yasui (*Saitama University*)

1AM2-2-1 Timbre Uniformity Visualization for Percussion Training Using Contrastive Loss

Proc. pp. 206–209

Akinori Maeda (*Shizuoka University*), Masafumi Nishimura (*Shizuoka University*)

This study examines the technique of playing uniform sound in fundamental techniques of percussion. Some systems have dealt with loudness, rhythm, and playing form deviations to

support practice. In contrast, this study focuses on timbre and expresses its uniformity through visualization. We propose a CNN-based model using contrastive loss, which reflects the human perception of air-conducted sound and discuss the difference in timbre uniformity between advanced players and beginners.

1AM2-2-2 Improved Throat Microphone Speech Recognition Using a Self-supervised Learning Model

Proc. pp. 210–213

Kohta Masuda (Shizuoka University), Jun Ogata (National Institute of Advanced Industrial Science and Technology), Masafumi Nishida (Shizuoka University), Masafumi Nishimura (Shizuoka University)

Throat microphones can simultaneously record speech and suppress external noise. This work aims to improve speech recognition performance using throat microphones within a high-noise environment. However, constructing a throat microphone speech recognition model is difficult because of the nonexistence of a large-scale throat microphone speech database. In our previous research, we proposed a fine-tuning method using pseudo-throat microphone speech generated via feature mapping for a pretrained model of wav2vec 2.0, a speech feature representation framework based on self-supervised learning (SSL). Speech recognition models are based on SSL models, whereas feature mapping uses supervised learning based on long short-term memory (LSTM); learning data that provides sufficient mapping accuracy is lacking. Hence, this study proposes a method to use SSL models in feature mapping. A comparison with the feature mapping method using LSTM, a conventional method, confirmed that using the feature mapping method using the SSL model improves recognition accuracy.

1AM2-2-3 Contrastive Mask Selection and Inpainting Convolution for Few-shot Anomalous Sound Detection

Proc. pp. 214–217

Ryosuke Tanaka (Gifu University), Junya Yamashita (Gifu University), Keisuke Ikeda (Gifu University), Satoshi Tamura (Gifu University), Satoru Hayamizu (Gifu University)

Anomaly sound detection is expected for industrial use such as machine inspection and failure prediction. In conventional schemes a detection model is built only using normal data, however, it is hard to appropriately learn features that discriminate normal and abnormal data due to the lack of knowledge about the abnormal data. Therefore, in this paper, an abnormal sound detection method is proposed using a large amount of normal data and a small amount of abnormal data, that is, few-shot anomaly data. Our scheme basically employs reconstruction-based approach using masks, consisting of three stages. First, pseudo abnormal data are generated using random masks from a small amount of abnormal data.

A mask evaluation model is then built based on contrastive learning. In the second stage, optimal masks are chosen to hide anomaly components properly, using the above model. Finally, we perform anomaly sound detection using the obtained masks according to reconstruction error. Experiments with a real-world dataset benchmarks were conducted and our methods was compared to a baseline.

1AM2-2-4 ANC System with Multiple Parametric Array Loudspeakers for Stable Noise Reduction Against Obstacles

Proc. pp. 218–221

Kazuho Yamaguchi (Nippon Institute of Technology), Masanori Kimoto (Nippon Institute of Technology)

One of the problems of active noise control using parametric array loudspeaker is that it is impossible to continue muffling when an obstacle appears between the control sound source and the muffling point. To solve this problem, we propose an ANC method using multichannel parametric array loudspeakers and tetrahedral error microphones. In this study, we show the performance of the proposed method in a real environment.

1AM2-2-5 Improvement of Performance for Feedback Active Noise Control in the Frequency Domain

Proc. pp. 222–224

Ryota Noguchi (Saitama university), Yosuke Sugiura (Saitama university), Nozomiko Yasui (Saitama university), Tetsuya Shimamura (Saitama university)

ANC can solve noise problems in various situations such as factories, transportation, and home appliances. Feedback ANC, which is one of typical ANCs, has two main problems, that are insufficient control performance for the periodic noise buried in the colored wide-band noise and high computational complexity. In this paper, we propose a method to improve the performance of feedback ANC on the frequency domain.

1AM2-2-6 Amplitude Spectrogram Prediction from Mel-Frequency Cepstrum Coefficients and Loudness Using Deep Neural Networks

Proc. pp. 225–228

Shoya Kawaguchi (National Institute of Technology Kagawa College), Daichi Kitamura (National Institute of Technology Kagawa College)

Timbre conversion of musical instrument sounds utilizing deep neural networks (DNNs) has been the subject of extensive research and continues to elicit significant interest in the development of more advanced techniques. We aim to

propose a novel algorithm for timbre conversion utilizing a variational autoencoder. However, this system must possess the capability of predicting the amplitude spectrogram from the mel-frequency cepstrum coefficient (MFCC) and loudness. The present research aims to build a DNN-based decoder that utilizes the MFCC and loudness as inputs to predict the amplitude spectrogram. Experiments using a musical instrument sound dataset indicate that a decoder incorporating bidirectional long short-term memory yields accurate predictions of amplitude spectrograms.

1AM2-3: Wireless Communication Systems 3

Date: 1 March, 11:00am to 12:40pm
 Room: ILIMA
 Chair: Hiraku Okada (Nagoya University)

1AM2-3-1 Simulation of Underwater Acoustic Communication Using a Directional Transducer Consisting of Multiple Reflectors

Proc. pp. 229–232

Ryotaro Chinone (University of Tsukuba), Tadashi Ebihara (University of Tsukuba), Yuji Sato (University of Tsukuba), Naoto Wakatsuki (University of Tsukuba), Yuka Maeda (University of Tsukuba), Koichi Mizutani (University of Tsukuba)

Underwater acoustic (UWA) communication is an essential technology to network underwater drones and sensors for more efficient underwater exploration. Most existing underwater acoustic communication systems use omnidirectional transducers for transmitting and receiving sound waves, which causes signal attenuation problems. On the other hand, the use of parabolic reflectors allows sound waves to be transmitted and received in a specific direction, thus achieving low power and simple communication. Therefore, in this paper, simulations are conducted to evaluate the performance of a directional transducer consisting of multiple reflectors. As a result, we found that UWA communication using reflectors consisting of multiple reflectors can become a viable device for low-power and simple communication.

1AM2-3-2 Measurement of Delay and Doppler Spreads in Shallow Water Environment for Mobile Underwater Acoustic Communication

Proc. pp. 233–236

Takuya Waki (University of Tsukuba), Tadashi Ebihara (University of Tsukuba), Naoto Wakatsuki (University of Tsukuba), Keiichi Zempo (University of Tsukuba), Koichi Mizutani (University of Tsukuba)

Underwater acoustic (UWA) communication, which achieves wireless communication by the transmission of acoustic waves underwater, is expected to be utilized for networking underwater drones. However, UWA communication is still challenging because of its large delay and Doppler spreads, which become barriers to reliable communication. Furthermore, the characteristics of the UWA channel also change when the transmitter (Tx) and receiver (Rx) are visible to each other (line-of-sight, LoS) or not (none line-of-sight, NLoS). Therefore, in this study, we measure the delay and Doppler spreads in shallow water environments and clarify their characteristics through experiments. The results show that the delay and Doppler spreads have different characteristics in the LoS and NLoS environments.

1AM2-3-3 3D indoor positioning system using tensor rank minimization based radio map interpolation

Proc. pp. 237–240

Makoto Osawa (Tokyo University of Science), Norisato Suga (Shibaura Institute of Technology), Yoshihiko Tsuchiya (Tokyo University of Science), Masaya Fujisawa (Tokyo University of Science)

With the increase in the number of wireless devices installed in indoor environments, the demand for indoor positioning systems is growing. The received signal strength fingerprinting method is one of the promising approaches for indoor positioning systems because it can utilize existing infrastructure such as Wi-Fi access points. In order to perform fingerprint-based positioning, a fingerprint database must be created in advance. The most common method for creating the database is to use a path loss model. However, this method cannot account for fading fluctuations. Therefore, in this study, we apply the tensor interpolation method, which can interpolate fading fluctuation components, to create fingerprints that include fading components. Then, we propose a 3D indoor positioning system that takes the fading component into account using a 3D radio map interpolated by tensor interpolation.

1AM2-3-4 A Study on Reinforcement Learning Algorithms to Reduce Power Consumption on BLE Advertisements with Maintaining Reliability

Proc. pp. 241–244

Minoru Fujisawa (Tokyo University of Science), Hiroyuki Yasuda (The University of Tokyo), Ryosuke Isogai (SEIKO FUTURE CREATION INC.), Yoshifumi Yoshida (SEIKO FUTURE CREATION INC.), Song-Ju Kim (SOBIN Institute LLC.), Mikio Hasegawa (Tokyo University of Science)

Bluetooth Low Energy (BLE) has been applied to a variety of IoT applications due to the spread of Bluetooth-enabled devices and their low power consumption. However, further

low power consumption can be achieved by efficient selection of advertisement intervals and channels. We propose an efficient selection method based on the Multi-Armed Bandit (MAB) algorithm, which takes the wireless environment into account for the channel and the advertising interval. In this paper, we evaluate the proposed method by simulations under various environments. The results show that the proposed method can reduce power consumption according to the wireless environment without significant loss of reliability. Furthermore, we confirmed that the proposed method works with actual BLE devices.

1AM2-3-5 Evaluation of IoT Malware-Disabling Method Using Large-Scale IoT Simulator

Proc. pp. 245–248

Yuki Ishida (SecureBrain), Kazuki Takada (SecureBrain), Kazuki Iwamoto (SecureBrain), Takeshi Misu (SecureBrain)

The prevalence of internet-of-things (IoT) malware threats has grown substantially over the past several years. Mirai is a representative malware that infects IoT devices. It has the capability to infect a large number of IoT devices and transmit a large amount of communication data from the infected IoT devices to the target servers, thus causing distributed denial-of-service attacks. Although IoT malware has been researched using real devices and virtual environments, very few experiments have been conducted on large-scale environments. Therefore, we extend our previously developed IoT malware simulator, which can simulate large-scale environments, and implement a simulator for a IoT malware-disabling method. In this study, we evaluate the usefulness of our IoT malware-disabling method that we proposed earlier using the large-scale IoT simulator. The evaluation is based on the amount of reduction in the attack traffic, which is calculated using the parameters collected from real device environments, from the viewpoint of network load reduction.

1PM1-1: SS2. Neural Prosthesis and WiBIC 1

Date: 1 March, 2:00pm to 3:40pm

Room: PLUMERIA

Chair: Hiroyuki Torikai (Hosei University)

1PM1-1-1 A Modified Hardware-Efficient Cochlear Model based on Ergodic Cellular Automaton Dynamics

Proc. pp. 249–252

Itsuki Kubota (Hosei University), Hiroyuki Torikai (Hosei University)

The mammalian ear consists of an outer ear, a middle ear,

and an inner ear typically, where a cochlea is the main sound processing unit in the inner ear. In order to analyze and reproduce such responses, many mathematical and electronic circuit models of cochleae have been presented. In this paper, a modified hardware-efficient cochlear partition model, the dynamics of which is described by an ergodic cellular automaton, is presented.

1PM1-1-2 Learning Attribute Curvilinear Coordinates for Pretrained Deep Generative Model

Proc. pp. 253–256

Takehiro Aoshima (Osaka University), Takashi Matsubara (Osaka University)

Deep generative models (e.g., generative adversarial networks (GANs)) are known for generating high-quality images. For editing generated images semantically, recent studies have proposed methods to manipulate latent codes along linear or nonlinear paths on the latent space. However, the quality of the image editing along linear paths is inferior, and the image editing along nonlinear paths is non-commutative. In this study, we propose deep curvilinear editing (DeCurvEd) to determine attribute curvilinear coordinates on the latent space. We theoretically and experimentally show that the quality of our method's image editing is better than comparison methods, and our method provides commutative image editing.

1PM1-1-3 Temporal Deep Unfolding-based MPC for Controlling Firing Patterns of Neuronal Network

Proc. pp. 257–260

Jumpei Aizawa (Osaka University), Masaki Ogura (Osaka University), Masanori Shimono (Kyoto University), Naoki Wakamiya (Osaka University)

Brain dynamics control is expected to improve human cognitive functions and treat neurological diseases. Currently, brain dynamics control is mainly performed on simulations, but this control is difficult due to the non-linearity of the neuron models. We attempted to control neuronal network dynamics in simulations by applying temporal deep unfolding-based model predictive control, which is considered to be effective for nonlinear models. As a result, we succeeded in controlling the firing time in a neuronal network with a small number of neurons.

1PM1-1-4 A hardware-efficient FPGA neuron model toward virtual clinical trial of brain prosthesis

Proc. pp. 261–264

Haruto Suzuki (Hosei University), Hiroyuki Torikai (Hosei University)

Various neuromorphic electronic circuits have been developed with an emphasis on medical engineering applications such as neural prosthetic devices. In this paper, an asynchronous cellular automaton (CA) neuron model to develop such a neural prosthetic device is presented. In addition, an automatic cellular differentiation method of the presented model to mimic the nonlinear dynamics of a biologically plausible neuron model is presented.

1PM1-1-5 Inverse Heat Dissipation Model for Image Segmentation

Proc. pp. 265–268

Yu Kashihara (Osaka University), Takashi Matsubara (Osaka University)

The diffusion model has shown excellent results in image generation and editing. These contributions stem from the ability to generate high-quality images. The diffusion model has the potential for segmentation into details. In this study, we propose an effective approach to segmentation tasks using the inverse heat dissipation model, one of the diffusion-based models. The proposed method generates a mask that shrinks to fit the shape of the interest region step by step. We evaluated the proposed method on the medical dataset of lung nodules segmentation. As a result, the proposed method obtains better results than existing methods and allows for more detailed segmentation.

1PM1-2: Artificial Intelligence and Machine Learning 5

Date: 1 March, 2:00pm to 3:40pm

Room: PAKALANA & ANTHURIUM

Chair: Tetsuya Shimamura (Saitama University)

1PM1-2-1 Application of multimodal methods to sign language motion classification and its effectiveness evaluation

Proc. pp. 269–272

Tsukasa Wakao (Kanagawa Institute of Technology), Yuusuke Kawakita (Kanagawa Institute of Technology), Hiromitsu Nishimura (Kanagawa Institute of Technology), Hiroshi Tanaka (Kanagawa Institute of Technology), Jin Mitsugi (Keio University)

With the development of miniaturized sensors, methods are now being proposed to improve classification accuracy by using multimodal information that combines data from multiple sensors. There are two approaches to multimodal methods that have been proposed, namely, (1) training, classifying information from multiple sensors indepen-

dently, and then integrating the results, and (2) combining information from multiple sensors prior to the training and classifying stages. This study adopts the latter approach and binds acquired coordinate and acceleration data to create multimodal information. In this paper, we describe a method for classifying sign language motions using the created multimodal information and demonstrate its effectiveness. We compared classification results using an evaluation indicator γ that we devised for this purpose. As a result, we were able to quantitatively confirm that the proposed classification method enhances classification performance.

1PM1-2-2 Multi Agent Deep Deterministic Policy Gradient based Fixed Wing Unmanned Aerial Vehicle Collision Avoidance System

Proc. pp. 273–276

Yuuki Watanabe (Ritsumeikan University), Tomohiro Fujita (Ritsumeikan University)

We attempted the automatic operation of a fixed-wing unmanned aerial vehicle using the reinforcement learning method called multi-agent deep deterministic policy gradient. Even when there are 4 agents in the operating environment, each agent was able to reach their landmark. We set each agent to have a one-to-one correspondence with the landmark and optimized the reward given to the agents. In our study, we independently set conditions and values for obtaining rewards so that agents can complete tasks faster. As a result, even in a complex environment with 4 agents, each agent was able to fly smoothly toward their respective goals while avoiding collisions.

1PM1-2-3 Temporal convolutional networks with feature selection for human manufacturing action analysis

Proc. pp. 277–280

Yuto Shimizu (Shizuoka University), Yoshitaka Yamamoto (Shizuoka University), Masafumi Nishimura (Shizuoka University), Yuki Shiono (Yamaha Motor Co. Ltd.), Reiki Shirasawa (Yamaha Motor Co. Ltd.), Takayuki Nakano (Yamaha Motor Co. Ltd.), Takahiro Aoki (Shizuoka University and Yamaha Motor Co. Ltd.)

Action Segmentation (AS) is an elemental technology that achieves work standardization and work assurance by segmenting time-series multi-modal data (from video, sound and sensor resources) representing actions into basic action units. MS-TCN (Multi-Stage TCN), an extension of the temporal convolutional network (TCN), is widely used as a generic AS proposed for supervised learning. However, it is difficult to understand which features are used for the segmentation process in the existing AS models including MS-TCN. Feature selection is a well-known technique to search for effective feature combinations used in the target machine learning model. In this study, we propose a novel method

obtained by introducing the feature selection technique into the TCN model in order to visualize the importance of features used for identifying each human action process.

1PM1-2-4 Multi-layer Cortical Learning Algorithm for Trend Changing Time-series Forecast

Proc. pp. 281–284

Kazushi Fujino (The University of Electro-Communications), Takeru Aoki (Tokyo University of Science), Keiki Takadama (The University of Electro-Communications), Hiroyuki Sato (The University of Electro-Communications)

We propose a burst-based multi-layer cortical learning algorithm (BM-CLA) for forecasting trend-changing time-series data. CLA predicts time-series data while adjusting synapse relationships online. However, the forecast accuracy deteriorates on trend-changing time-series data, which switches several time-series trends over time. The proposed BM-CLA detects trend changes based on multi-layered CLA predictors. Experimental results using artificial time-series data involving multiple trends showed that the BM-CLA achieves higher forecast accuracy than conventional CLAs and LSTM, which is a neural network-based forecast algorithm.

1PM1-2-5 Estimating children's classroom participation using machine learning methods

Proc. pp. 285–288

Mayuko Maruyama (Tamagawa University), Masahiro Miyata (Tamagawa University), Tetsuji Yamada (Tamagawa University), Takeshi Aihara (Tamagawa University), Takashi Omori (Tamagawa University)

The quality of teaching is important in education, and it has been improved by reflecting on the daily classes by teachers. However, there is a problem that it takes a lot of time for the review. To solve this problem, we have proposed and developed a system that supports reflection using AI technology to estimate the class situation and provide the results to the teachers. In this paper, we consider that the class participation of each child can be estimated from the amount of his or her behavior. Therefore, we tried to estimate the class participation by extracting the amount of child's behavior using the support system we have developed so far and applying machine learning methods to it.

1PM1-3: Communication & Sensor Networks

Date: 1 March, 2:00pm to 3:40pm

Room: ILIMA

Chair: Kosuke Sanada (Mie University)

1PM1-3-1 A Guaranteed QoE Provision using Software Defined Networking and Cryptocurrency

Proc. pp. 289–292

Hideya Masaki (Chiba University), Kien Nguyen (Chiba University), Hiroo Sekiya (Chiba University)

With remarkable research and development efforts, mobile wireless networks are entering the 5G era. In the post-5G era, the emergence of high-quality services (VR/AR, 4K/8K video streaming, etc.) is expected to lead to more diverse user requirements for network resources. To satisfy such User Experience (UX), it is essential to provide a highly granular Quality of Experience (QoE) while having a reasonable payment method such as pay-as-you-go. This paper proposes a system that achieves per-flow QoE provisioning with micropayment using two advanced technologies (i.e., Software Defined Networking (SDN) and the distributed ledger IOTA). We have implemented and evaluated the proposed system on the network emulator Mininet-WiFi. The evaluation results show that the system can provide guaranteed QoE for VoIP and video streaming applications following a micropayment.

1PM1-3-2 Contents Acquisition Method Using Caching List in the Information-Centric Wireless Multi-Hop Networking

Proc. pp. 293–296

Shogo Hinata (Kanagawa Institute of Technology), Shigeki Shiokawa (Kanagawa Institute of Technology)

In recent years, information centric networking (ICN) that communicate based on transmitted and received content have been attracting attention instead of host-oriented networks that communicate based on IP. ICN is applied to in a wireless network environment, where mobile (nodes) do not use IP. Since it is assumed that a node in the wireless ICN operates with limited power, flooding at the time of content request, which is the basic ICN communication procedure, may cause considerable power loss. In this research, we propose a method to reduce flooding and power consumption when requesting content by sharing the caching content list with surrounding nodes.

1PM1-3-3 High Speed Optimization of NOMA System Using Coherent Ising Machine in Dynamic Environment

Proc. pp. 297–300

Tepei Otsuka (Tokyo University of Science), Aohan Li (The University of Electro-Communications), Hiroki Takesue (NTT Basic Research Laboratories NTT Corporation), Kensuke Inaba (NTT Basic Research Laboratories NTT Corporation), Kazuyuki Aihara (International Research Center for Neuro intelligence The University of Tokyo),

Mikio Hasegawa (Tokyo University of Science)

Non orthogonal multiple access (NOMA) method has been proposed as one of the key technologies for next-generation wireless networks. In order to take advantage of the NOMA method, optimal resource allocation (RA), such as power and channel allocation, must be optimized. The coherent Ising machine (CIM) has been proposed as an Ising machine that can solve the Ising problem at high speed. In this study, we apply the CIM to NOMA RA problem and evaluate performance. Specifically, NOMA RA problem is formulated and transformed into an Ising problem. Simulation results show that the proposed method achieves superior performance in terms of optimal solution attainment rate.

1PM1-3-4 Performance Demonstration of Decentralized TDMA Based on Desynchronization of Nonlinear Oscillators with Different Coupling Schemes

Proc. pp. 301–304

Takuma Osada (Tokyo University of Science), Hiroyuki Yasuda (The University of Tokyo), Mikio Hasegawa (Tokyo University of Science)

The design of MAC protocols for the IoT has become important due to the rapid growth in the number of IoT devices. In order to realize efficient and large-scale wireless networks, autonomous distributed time division multiple access (TDMA) has been studied in previous research. Our previous study has proposed a distributed TDMA suitable for the massive IoT network, which is based on the desynchronization phenomenon of a nonlinear oscillator network with intermittent and inhibitory couplings. In this paper, we propose a performance-improving method for our desynchronization method by changing the coupling functions of the nonlinear oscillator networks. Our simulation results demonstrate that the convergence time to achieve a desynchronization state for TDMA communication can be reduced by modifying the coupling function, such as the linear and cosinusoidal functions.

1PM1-3-5 A Novel Energy Efficient Clustering Using a Sleep Awake Algorithm for Energy Harvesting Wireless Sensor Networks

Proc. pp. 305–308

Shuntaro Takie (Tokyo University of Science), Ryo Shibata (Tokyo University of Science), Hiroyuki Yashima (Tokyo University of Science)

Energy Harvesting Wireless Sensor Network (EH-WSN) harvesting environmental renewable energy (solar) are used for environmental monitoring. We propose a new routing protocol as novel energy efficient clustering (NEEC) using a sleep awake algorithm(SA). This protocol is called NEEC-SA. In the proposed protocol, two sensor nodes form

sub-clusters and one of which becomes CH and another one turns into sleep mode. Simulation results show that the proposed method improves the network stability, comparing to NEEC.

1PM2-1: SS2. Neural Prosthesis and WiBIC 2

Date: 1 March, 4:00pm to 5:20pm

Room: PLUMERIA

Chair: Hiroyuki Torikai (Hosei University)

1PM2-1-1 Nonlinear Sound Processing Functions of An FPGA Integrated Cochlear Model

Proc. pp. 309–312

Yui Kishimoto (Hosei University), Hiroyuki Torikai (Hosei University)

In this paper, a novel hardware-efficient integrated cochlear model, whose nonlinear dynamics is described by ergodic sequential logics (SL), is presented. It is shown that the presented cochlear model can reproduce combination tone generation of a mammalian cochlea, which is one of the most typical nonlinear sound processing functions of mammalian cochleae.

1PM2-1-2 On Loss Function for Deep Learning of Physical Systems

Proc. pp. 313–316

Takahito Yoshida (Graduate School of Engineering Science Osaka University), Takaharu Yaguchi (Graduate School of System Informatics Kobe University), Takashi Matsubara (Graduate School of Engineering Science Osaka University)

Most real-world systems, including natural phenomena, human interactions, and industrial machinery, have been automatically modeled from data with neural networks. Neural ordinary differential equation (Neural ODE), combining neural networks to model the time-derivative f with sophisticated numerical integrators and adjoint methods, has taken this research field to a new level and has created many followers. However, the training strategy of neural ODE and related methods is not yet established. In this paper, we propose the error-analytic strategy as a new strategy for training neural ODEs to be more accurate in long-term predictions when many observations are given per a time-series.

1PM2-1-3 Platform Design for Wireless Brain-Inspired Computing

Proc. pp. 317–320

Ryuji Nagazawa (Chiba University), Jiaying Lin (Chiba University), Kien Nguyen (Chiba University), Won-Joo Hwang (Busan National University), Hiroyuki Torikai (Hosei University), Mikio Hasegawa (Tokyo University of Science), Hiroo Sekiya (Chiba University)

We propose a new distributed information processing platform integrating spiking neural networks and IoT networks. we call this platform Wireless Brain-Inspired Computing: WiBIC. This study proposes a WiBIC system platform based on WSNs employing Asynchronous Pulse Code Multiple Access methods, which can transmit by small fluctuations in transmission delay. This characteristic allows WiBIC to operate stably. Furthermore, we experimented XOR function using the WiBIC platform with the Spike Timing Dependent Plasticity learning rule. The results show that the WiBIC system is able to acquire the learning function.

1PM2-1-4 Analysis of influence of wireless communication on dynamics of neural networks

Proc. pp. 321–324

Shota Kawakami (Osaka University), Naoki Wakamiya (Osaka University)

Embedding an artificial neural network on a wireless IoT network enables ubiquitous and ambient computation at the edge of information systems. However, it suffers from unreliable and unstable wireless communication causing delay and loss of information. In this paper, to evaluate the influence of wireless communication protocols on the dynamics of a spiking neural network when divided into two wireless modules, we conduct simulation experiments. We found that pure ALOHA with retransmission resulted in the smallest change compared with pure ALOHA without retransmission and CSMA/CA.

1PM2-2: Image & Video Signal Processing

Date: 1 March, 4:00pm to 5:20pm

Room: PAKALANA & ANTHURIUM

Chair: Masatoshi Sato (Tamagawa University)

1PM2-2-1 APDID: IQA Database Specialized For Printing Images

Proc. pp. 325–328

Ryosuke Tonegawa (Saitama University), Yosuke Sugiura (Saitama University), Nozomiko Yasui (Saitama University), Tetsuya Shimamura (Saitama University)

Recently, importance of dataset in deep learning has been

increased. Nevertheless there is no dataset for image quality assessment with printing-specific defects. In this paper, we provide the Artificial Printing Defect Image Dataset (APDID). This dataset consists of 3,720 images with 55 print-specific degradations and degradation scores from 1,200 subjects gathered through crowdsourcing. This paper proves reliability of APDID through statistical analysis. APDID is expected to be sufficiently effective as a training dataset for a system that detects printing errors or evaluates the print quality of printers.

1PM2-2-2 Detection Method of Leaf Cutting Point for Tomato Leafcutter Robot Using Depth Camera

Proc. pp. 329–332

Hirokazu Kariyama (Tokushima University), Hiroshi Suzuki (Tokushima University), Takahiro Kitajima (Tokushima University), Akinobu Kuwahara (Tokushima University), Takashi Yasuno (Tokushima University)

This paper describes a leaf cutting point detection method for the tomato leafcutter robot by image processing using a depth camera. As the first step of cutting point detection, the main stem of tomatoes is detected since the cutting points are considered to exist along the main stem. Next, the cutting points are detected as branches perpendicular to the main stem with an appropriate width at a certain distance from the main stem. In addition, control of a robot arm is described using X-Y table and the six-joints vertical robot arm. Usefulness of the proposed cutting point detection algorithm is verified from several experimental results using the robot arm in a tomato greenhouse.

1PM2-2-3 Telephone Unit Detection and LED Color Recognition by Image Processing

Proc. pp. 333–336

Shuto Suzuki (Gifu University), Junya Sato (Gifu University), Ryoya Suzuki (IWATSU ELECTRIC Co. LTD.), Ichiro Sudo (IWATSU ELECTRIC Co. LTD.), Kyosuke Yamawaki (IWATSU ELECTRIC Co. LTD.)

In a manufacturing process of key telephone system, there is an inspection process for a circuit board called a unit. The inspection procedure is defined in detail. However, human error can occur. To check it, this study aims to develop an image processing method to automatically recognize the inspection status using a camera.

1PM2-2-4 Misplacement Detection of a Forged Part by Image Processing

Proc. pp. 337–339

Mizuki Ito (Gifu University), Junya Sato (Gifu University), Kosei Umemura (ASAHI FORGE CORPORATION),

Chikara Ito (ASAHI FORGE CORPORATION), Hidenobu Masuda (ASAHI FORGE CORPORATION)

There is work to put a forged part on a machine in a machining process of forged parts. Because misplacement sometimes occurs, it is necessary to check whether the placement is normal or abnormal. To check it automatically, we propose an image processing-based method in this study.

1PM2-2-5 Visual Archive Search Using Vision-language Object Detection Models

Proc. pp. 340–343

Ryuichi Tomiya (Kobe University), Tristan Hascoet (Kobe University), Ryoichi Takashima (Kobe University), Tetsuya Takiguchi (Kobe University)

Recently, by adding natural language understanding to computer vision, object detection models can detect nuanced concepts from free-form text without specific training. A visual search is important to understanding accidents and the extent of the damage in natural disaster response and planning. In this paper, we discuss the use of a vision-language object detection model to carry out a visual search of an image archive of an earthquake disaster. We will demonstrate the effectiveness of a vision-language object detection model in the field of object detection by varying the level of complexity of the image-related text to detect objects such as "a backpack", "a safety cone", "a blue tarp", "a person sitting", "a person wearing a helmet", and "a person riding a bike". We will also compare the accuracy of vision-language object detection models and an open-vocabulary image classification model in visual searches and analyze the tendency.

1PM2-3: SS1. Recent Progress of VLC for 6G

Date: 1 March, 4:00pm to 5:20pm

Room: ILIMA

Chair: Shintaro Arai (Okayama University of Science)

1PM2-3-1 Development of An Experimental System for Image Sensor Communication Using a Rotary LED Transmitter and Low-Speed Camera Receiver

Proc. pp. 344–347

Shintaro Arai (Okayama University of Science), Zhengqiang Tang (Nagoya University), Tomohiro Yendo (Nagaoka University of Technology)

Image sensor communication (ISC) is a visible light communication using a light-emitting diode (LED) as a transmitter and a camera as a receiver. This study focuses on a rotary

LED transmitter (RLT) that we developed to improve the communication speed of ISC. RLT rotates LEDs that send data while blinking, and the receiver side can capture these lights as multiple afterimages to improve communication speed. Although we evaluated the performance of RLT, the experiments in our previous study were conducted after capturing the received images and demodulating the data using them. To realize ISC, the receiver needs to demodulate the data in real-time in the order of receipt of the captured images by the camera. We are currently developing an experimental system for real-time ISC using RLT to realize the ISC system. This paper describes our ISC experimental system under development. As a result of the experiment, we visually confirmed that the receiver demodulates in real-time using the pre-detected coordinate information of LED lights.

1PM2-3-2 Non-uniform Grid-based Optical Fingerprint Positioning on VN-CSK System

Proc. pp. 348–351

Daisuke Ogawa (Ibaraki University), Yuta Ochiai (Ibaraki University), Yusuke Kozawa (Ibaraki University), Hiromasa Habuchi (Ibaraki University)

In this paper, the optical fingerprint positioning system with non-uniform grid is proposed to reduce the variance of positioning error. The positioning system uses signal intensity patterns at the reference points to search a nearest point from a receiver. The proposed system determines the arrangement of reference points with a nonlinear function, that is a mu-law function, and it makes difference in density of reference points. Consequently, it is found that the proposed method is better than the conventional method with uniform grid points in terms of the variance of positioning errors. When "mu" of the mu-law function is set to 1.1, the variance of the positioning error of the proposed method is 25% smaller than that of the conventional method. When the number of grid points is larger than 7 times 7, it is shown that there is "mu" where the proposed method outperforms the conventional method.

1PM2-3-3 Comparison of Trilateration Method and Optical Fingerprinting Method Based on Optical-Wireless VN-CodeSK System

Proc. pp. 352–355

Yuta Ochiai (Ibaraki University), Daisuke Ogawa (Ibaraki University), Yusuke Kozawa (Ibaraki University), Hiromasa Habuchi (Ibaraki University)

In this paper, the trilateration and the optical fingerprinting method in the optical-wireless communication system using Variable N-parallel Code Shift Keying (VN-CodeSK) system are compared from the viewpoint of positioning error. It is found that the optical fingerprinting method has better positioning error performance than the trilateration method in

the area affected by the reflected wave from the wall, but the trilateration method is superior to the optical fingerprinting method in other areas.

1PM2-3-4 A Proposal of Hidden Screen-Camera Communication Systems Using Adversarial Examples on CNN Depth Estimation Model

Proc. pp. 356–359

Changseok Lee (Nagoya University), Hiraku Okada (Nagoya University), Tadahiro Wada (Shizuoka University), Chedlia Ben Naila (Nagoya University), Masaaki Katayama (Nagoya University)

A screen-camera communication has been proved that it is cost-efficient and intuitive to common users. Furthermore, hidden screen-camera communication can transfer both data and visual information at the same time. Consequently, it requires robust communication performance while not affecting visual quality too much. In order to achieve those requirements, we propose a hidden screen-camera communication system using adversarial examples on a convolutional neural network (CNN) depth estimation model. An adversarial example on the CNN depth estimation model can change the output of the CNN model while being invisible from human vision system. We take advantage of the adversarial examples to embed data into the output of the CNN depth estimation model to achieve hidden screen-camera communication. In this study, we try to find out whether our proposed method can achieve both robust communication performance and acceptable visual quality. From simulation experiment where we do not consider noise or distortion, our proposed method achieved average BER of 0.015 with PSNR of 32 dB. This shows our method could be the same or better than existing methods. In conclusion, we proposed method using adversarial examples which are applied to CNN depth estimation model. Also, we demonstrated possibilities of our method by simulation experiment. For future study, we will valid this method by real-world environment experiment which will contain noise and distortion.

1PM2-3-5 Enhanced xASK-CodeSK for SLIPT

Proc. pp. 360–363

Yu Ichitsuka (Ibaraki University), Yusuke Kozawa (Ibaraki University), Hiromasa Habuchi (Ibaraki University)

Recently, sensor devices have been spreading rapidly due to the development of the IoT. They are often battery-driven and therefore have limited energy capacity. In order to extend the operating time while maintaining communication function, the Simultaneous Lightwave Information and Power Transfer (SLIPT) is in demand. In this research, the bit success rate (BSR) and power transfer rate (PTR) of enhanced xASK-CodeSK are evaluated by using theoretical formulas. The result indicates that there is a trade-off relationship between

the BSR and PTR.

2AM1-1: Nonlinear Applications

Date: 2 March, 9:20am to 10:40am

Room: PLUMERIA

Chair: Yoshitaka Itoh (Hokkaido University of Science)

2AM1-1-1 Attitude Control of Biped Hopping Robot Using an Inertial Rotor

Proc. pp. 364–367

Ayumu Kato (Tokushima University), Hiroshi Suzuki (Tokushima University), Takahiro Kitajima (Tokushima University), Akinobu Kuwahara (Tokushima University), Takashi Yasuno (Tokushima University)

This paper proposes an attitude stabilization control for a biped hopping robot with springs and closed link legs mechanism. The robot has an inertial rotor to stabilize the attitude combination with the swinging control of the leg. The attitude stabilization control is realized using integral-type optimum servo controller which is designed on the basis of LQR method. Attitude of the robot is estimated from the acceleration of the robot body measured by an IMU. Experiments using this system are conducted to confirm the attitude stabilization performances compared with the simulation results.

2AM1-1-2 Local Search Method for Solving Min-Max multiple Bike Sharing System Routing Problem

Proc. pp. 368–371

Takafumi Matsuura (Nippon Institute of Technology)

In a bike-sharing system, multiple vehicles restore the number of bicycles at each port. To decide the shortest tours of all vehicles, the multiple bike sharing system routing problem (mBSSRP) has been proposed. The aim of mBSSRP is to determine the shortest tours for multiple vehicles. In this paper, we propose a new mBSSRP called "min-max mBSSRP." The goal of the min-max mBSSRP is to minimize the work time of the vehicle with the maximum work time. For small instances, the optimal solution can be obtained by a general-purpose mixed integer linear programming solver. However, for large instances, the optimal solution could not be found within a reasonable time. Therefore, in this paper, we propose a simple local search method to find near-optimal solutions of the min-max mBSSRP in a short time.

2AM1-1-3 Similarity-based Multi-factorial Evolutionary Algorithm for Binary Optimization Problems

Proc. pp. 372–375

Shio Kawakami (*The University of Electro-Communications*), Shoichiro Tanaka (*The University of Electro-Communications*), Keiki Takadama (*The University of Electro-Communications*), Hiroyuki Sato (*The University of Electro-Communications*)

To enhance multi-factorial discrete optimization using evolutionary algorithms by encouraging the cooperative search among searches for different objectives, we proposed MFEA/OSD (MFEA based on objective similarity for discrete problems), which estimated objective similarities in the discrete variable space and utilized them for the cooperative search. Experimental results on multi-factorial CMNK landscape problems showed that the proposed MFEA/OSD showed higher multi-factorial optimization performance than the conventional single objective EA and MFEA.

2AM1-1-4 Improving Signal Detection Performance of Successive Interference Cancellation with Nonlinear System by Applying Stochastic Resonance

Proc. pp. 376–379

Yuta Tomida (*Mie University*), Hiroyuki Hatano (*Mie University*), Kosuke Sanada (*Mie University*), Kazuo Mori (*Mie University*)

In the 5th generation mobile communication system (5G), a multiuser multiplexing scheme, Non-Orthogonal Multiple Access (NOMA) has been proposed to accommodate the massive connectivity in wireless communication systems. By the non-orthogonality, NOMA allows a new domain which is ineffectively utilized in the conventional Orthogonal Multiple Access (OMA) schemes. In Power-Domain NOMA (PD-NOMA), user signals are allocated different power levels and multiplexed using superposition coding at a transmitter. NOMA employs interference cancellation schemes such as Successive Interference Cancellation (SIC) at receivers to avoid interference between the signals. Using nonlinear systems such as low-resolution analog-to-digital converters (ADCs) is favorable in terms of energy consumption, since the load of SIC processes increases in proportion to the number of users. However, on the other hand, the nonlinear system leads to degradation in signal detection performance. Stochastic Resonance (SR) is a nonlinear phenomenon which improves the response of nonlinear systems to weak power signals. In this study, we propose the application of SR to the nonlinear system in SIC. Through computer simulations, we show the proposed method can improve the signal detection performance without losing the advantage in terms of energy consumption.

2AM1-2: Artificial Intelligence and Machine Learning for Time Series

Date: 2 March, 9:20am to 10:40am

Room: PAKALANA & ANTHURIUM

Chair: Hiroshi Suzuki (Tokushima University)

2AM1-2-1 Investigation of Sound Data with Three Types of Noise-Mixing Effects by Neural Network Using Autocorrelation Function

Proc. pp. 380–383

Takuya Nakamura (*Tokushima University*), Ryosuke Shimizu (*Tokushima University*), Yoko Uwate (*Tokushima University*), Yoshifumi Nishio (*Tokushima University*)

One-dimensional convolutional neural networks (1D-CNN) are used for time series analysis. However, noise mixed in the data can interfere with time series analysis. Therefore, we compare the classification accuracy of two types of patterns. One is a pattern learned by mixing three kinds of noise (white noise, pink noise, and red noise) into the data, and the other is a pattern learned by replacing the original data with an autocorrelation function (ACF).

2AM1-2-2 Time Series Classification Using Neural Networks with Chaotic Feature Extraction For Multiple Data

Proc. pp. 384–387

Ryosuke Shimizu (*Tokushima University*), Yoko Uwate (*Tokushima University*), Yoshifumi Nishio (*Tokushima University*)

Time series classification is an important and challenging problem in data analysis. Recently, time series analysis using neural networks (NN) has attracted much attention. However, the analysis of time series data with complex oscillations is difficult. Therefore, it is important to search for effective features of the data. The chaotic features are used to search for effective features. However, time-series signals contain a mixture of chaotic and non-chaotic features, so preprocessing is important. In this study, we perform preprocessing appropriate for the data to find chaotic features and compare them. Next, the dimensionality of the data is transformed, and the time-series data is classified using chaotic features using NN.

2AM1-2-3 Effects of synaptic scaling on spontaneous firing activity in spiking neural networks with modular structure

Proc. pp. 388–391

Takumi Shinkawa (*Oita University*), Hideyuki Kato (*Oita*)

University), Yoshitaka Ishikawa (Future University Hako-date), Takuma Sumi (Tohoku University), Hideaki Yamamoto (Tohoku University), Yuichi Katori (Future University Hako-date)

Our research group is trying to implement reservoir computing with cultured neuronal networks with modular structures. This study aims to obtain theoretical insights that help design biological experiments on cultured neuronal networks. In particular, we focus on the homeostasis of spontaneous neuronal activities due to synaptic scaling. Then, we examine how the synaptic scaling works in a spiking neural network model with modular structures for different network sizes and modularities by numerical simulations. Our simulations revealed that the synaptic scaling contributed to the homeostasis of inhibitory neurons more than excitatory neurons in modular spiking neural networks with larger network sizes.

2AM1-2-4 Preliminary Study of Adaptive Synapse Generation in Cortical Learning Algorithm

Proc. pp. 392–395

Takeru Aoki (Tokyo University of Science), Keiki Takadama (The University of Electro-Communications), Hiroyuki Sato (The University of Electro-Communications)

The cortical learning algorithm (CLA) is a time-series data prediction algorithm based on the human neocortex including synapses and other memory elements. CLA treats discrete values converted from the continuous input values. CLA cannot reflect the resolution of discretization to the internal representation of the predictor due to the synapse arrangement fixed at the initialization process. In this work, we propose a CLA that adaptively generates the synapses according to the input. Experimental results on an electricity load prediction task show that the prediction accuracy of CLA is improved by the proposed method.

2AM2-1: Wireless Communication Systems 4

Date: 2 March, 11:00am to 12:20pm

Room: PLUMERIA

Chair: Kien Nguyen (Chiba University)

2AM2-1-1 Routing and Caching Optimization in Autonomous Mobility-Assisted Piggyback Network with mmWave Links

Proc. pp. 396–399

Daisuke Yamamoto (Tokyo University of Science), So Hasegawa (National Institute of Information and Communications Technology), Yozo Shoji (National Institute

of Information and Communications Technology), Mikio Hasegawa (Tokyo University of Science)

Piggyback Network has the potential to provide a high-capacity data distribution platform, which utilizes a store-carry-forward data transfer scheme among the autonomous mobilities equipped with extremely high-speed wireless communication using a high frequency band, such as millimeter-wave. This network has more potential to expand the high-speed wireless data collection and distribution area through the mobilities than the existing wired/wireless infrastructures. Utilizing cache-able autonomous mobilities and sharing large data files among mobilities at a proximity chance by the short-range and high-speed wireless links could lead to increase the network capacity. However, it is necessary to consider a dynamic content caching method because storage resources are limited. In this paper, we propose a routing and caching optimization method for autonomous mobilities that considers content transfer time and popularity in the Piggyback Network. The results show that the Piggyback Network with routing and caching optimized for autonomous mobilities enables higher throughput for high-capacity data transfers than conventional cellular communication.

2AM2-1-2 A study of Direct Decoding Adopting LDM in Partial Reception Band in Next-Generation Digital Terrestrial Television Broadcasting

Proc. pp. 400–403

Yoko Tanaka (Tokyo University of Science), Akira Nakamura (Kanagawa University), Makoto Itami (Tokyo University of Science)

In Japanese next-generation digital terrestrial television broadcasting (DTTB) for ultrahigh-definition television (UHDTV) broadcasting, application of Layered Division Multiplexing (LDM) is being studied. One of the decoding schemes is direct decoding. However, reception performances when Quadrature Amplitude Modulation (QAM) such as Uniform Quadrature Amplitude Modulation (U-QAM) and Non-Uniform Quadrature Amplitude Modulation (NU-QAM) is changed have not compared yet in direct decoding. This paper reports two results. First, comparison of Gray mapped LDM (GLDM) and normal LDM is indicated. GLDM is effective to improving reception characteristic of fixed reception. Next, the required carrier-to-noise ratio (CNR) using Uniform QAM (U-QAM) and NU-QAM in direct decoding adopting LDM in partial reception band in next-generation DTTB. NU-QAM is indicated to improve the required CNR compared with U-QAM in 16QAM and 64QAM.

2AM2-1-3 IRS Reflection Pattern Prediction Considering Receiver's Moving Speed

Proc. pp. 404–407

Yoshihiko Tsuchiya (Tokyo University of Science), Norisato Suga (Sugaura Institute of Technology), Kazunori Uruma (Kogakuin University), Masaya Fujisawa (Tokyo University of Science)

The use of Intelligent Reflecting Surface (IRS) is being considered for wireless communications in the high frequency band. For the prediction of IRS reflection patterns, a method has been studied that accounts for receiver movement by treating the partially observed channel estimates as a time series from the current time to a certain period of time in the past. However, the method does not take into account the moving speed of the receiver, which degrades prediction performance when a variety of speeds exist. Therefore, this study proposes a prediction method that uses channel amplitude differences as an indicator to capture movement speed. Numerical experiments show the improvement of the prediction performance of the proposed method.

2AM2-1-4 Improvement of Automated Modulation Classification Using Independent Component Analysis
Proc. pp. 408–411

Naoyuki Funabashi (Saitama University), Yosuke Sugiura (Saitama University), Nozomiko Yasui (Saitama University), Tetsuya Shimamura (Saitama University)

With increasing demand for wireless communications, a shortage of usable radio spectrum has become a big problem. Automatic Modulation Classification (AMC) plays an important role in efficiently utilizing the spectrum. AMC is a technique for estimating the modulation scheme used in a received signal without any pilot with modulation scheme information. For accurate detection, AMC system is required to provide robustness against the influence of noise and fading on the received signal. In this paper, Independent Component Analysis (ICA) is used in pre-processing of AMC to cancel the fading effects.

2AM2-2: Applications of Signal Processing

Date: 2 March, 11:00am to 12:40pm
Room: PAKALANA & ANTHURIUM
Chair: Tomohiro FUJITA (Ritsumeikan University)

2AM2-2-1 Forex Trading Strategy That Might Be Executed Due to the Popularity of Gotobi Anomaly
Proc. pp. 412–415

Hiroki Bessho (Ibaraki University), Takanari Sugimoto (Gaika ex byGMO Inc.), Tomoya Suzuki (Ibaraki University)

Our previous research has confirmed that the USD/JPY rate tends to rise toward 9:55 every morning in the Gotobi days divisible by five. This is called the Gotobi anomaly. In the present study, we verify the possible trading strategy and its validity under the condition that investors recognize the existence of the anomaly. Moreover, we illustrate the possibility that the wealth of Japanese companies might leak to FX traders due to the arbitrage opportunity if Japanese companies blindly keep making payments in the Gotobi days as a business custom.

2AM2-2-2 Long-Term Modeling of Financial Machine Learning with Multiple Time Scales
Proc. pp. 416–419

Kazuki Amagai (Ibaraki University), Riku Tanaka (Daiwa Asset Management Co.Ltd.), Tomoya Suzuki (Ibaraki University and Daiwa Asset Management Co.Ltd.)

In asset management businesses, such as portfolio management, it is common to operate in the medium to long term due to the increase in operational burden and transaction costs. However, to compose a longer-term model the number of usable learning data decreases; hence, the model performance declines. To solve this problem, in this study, a data augmentation was conducted by the combined use of data of multiple time scales, and confirm its effectiveness to keep a better generalization ability of trained models even if the target task of machine-learning methods is longer time scale. In addition, portfolio management was conducted using the constructed model.

2AM2-2-3 Composition of Thematic Equity Funds by Searching Multi and Unknown Words
Proc. pp. 420–423

Zijie Luo (Ibaraki University), Ziyi Dai (Ibaraki University), Tomoya Suzuki (Ibaraki University), Wataru Kuramoto (Daiwa Asset Management Co.Ltd)

The previous research has confirmed that their fund-search system can select companies with a high degree of relevance to arbitrary search words by text mining disclosure documents of companies. One of its features is that any search words are converted to Word2Vec so that users can search with ambiguous search words as they intend. However, complex searches involving multiple words and/or unknown words are not yet supported. Therefore, in our study, we consider how to realize multiple and unknown word search by using “AND” and “OR” for multiple words and using the fasttext model for unknown words. For some tests to evaluate our method, we obtained the companies listed in MINKABU website where human analysts picked up companies suitable for trendy themes of equity funds, and consider them as the correct companies that our method has

to search automatically. The given results are shown in Tables 1 and 2 whose details will be discussed in the next 4-page full paper.

2AM2-2-4 A parallel nuclear norm minimization algorithm for matrix rank minimization problems

Proc. pp. 424–425

Katsumi Konishi (Hosei University), Tyohei Sasaki (Tokyo University of Technology)

This paper deals with matrix rank minimization problems. Several algorithms have been proposed and achieve good performance. While nuclear norm based algorithms take high computational cost for large matrices derived from the singular value decomposition (SVD), GPU computing can reduce their computing time. However, due to the limitations of memory, GPU computing is not available for enormous matrices. In order to apply GPU computing to a nuclear norm minimization algorithm for enormous matrices, this paper proposes a parallel nuclear norm minimization algorithm, which can utilize parallel computing. Numerical examples show that the proposed algorithm reduces computing time via multiple CPUs.

2AM2-2-5 Investigation of Partial Update and Source Localization in Geometrically Constrained Independent Vector Analysis with Auxiliary Function Approach for Moving Source

Proc. pp. 426–429

Kana Goto (University of Tsukuba), Tetsuya Ueda (Waseda University), Li Li (NTT Communication Science Laboratories Nippon Telegraph and Telephone Corporation), Takeshi Yamada (University of Tsukuba), Shoji Makino (Waseda University)

In this paper, we applied an efficient partial update to online geometrically constrained independent vector analysis with auxiliary function approach and iterative source steering (oGC-AuxIVA-ISS) and evaluated its effectiveness for moving source separation when using DOA estimation. The algorithm fully exploits the advantages of the auxiliary function approach, i.e., fast convergence and no stepsize tuning, and ISS, i.e., low computational complexity and numerical stability, making it highly suitable for practical use. In addition, ISS provides a more efficient way to deal with moving sources by partially updating the demixing filters corresponding to them. Experimental results showed that the separation performance of oGC-AuxIVA-ISS with partial updates was higher than that of the conventional method without ISS with partial updates. Furthermore, it was shown that DOA estimation based on delay-and-sum could further reduce runtime.

3AM1-1: Bifurcation and Chaos

Date: 2 March, 11:00am to 12:20pm

Room: PLUMERIA

Chair: Takashi Matsubara (Osaka University)

3AM1-1-1 Information entropy of transition probability matrix obtained from chaotic time series data

Proc. pp. 430–433

Akinori Kato (Tokyo Denki University), Yoshitaka Itoh (Hokkaido University of Science), Masaharu Adachi (Tokyo Denki University)

In this research, we propose a method for computing the information entropy from transition probability matrix, and compare it with the Lyapunov exponent of time series data.

3AM1-1-2 Verifying Robustness of Parameter Space Estimation for Predicting a Critical Transition

Proc. pp. 434–437

Yoshitaka Itoh (Hokkaido University of Science)

We verify that a parameter space estimation for predicting a critical transition is robust against dynamical noise with several noise intensities. Many researchers detected critical transitions by using early warning signals in recent years. Although various research groups have shown the usefulness of early warning signals for various problems, the early warning signals cannot predict when a critical transition occurs. For predicting the critical transition, we use the parameter space estimation to plot a bifurcation diagram only from several time-series data sets. By plotting the bifurcation diagram, we can predict when the critical transition occurs, because some critical transitions have dynamics that are similar to those of a saddle-node bifurcation. In addition, the ridge regression is used as a training method to reduce the effect of noise. We compare the success rates for predicting the critical transition using several normalization parameter values of the ridge regression.

3AM1-1-3 Periodic Input Leads an Izhikevich Neuron to Induce both Periodic and Irregular Responses

Proc. pp. 438–441

Yota Tsukamoto (Tokyo University of Science), Honami Tsushima (Tokyo University of Science), Tohru Ikeguchi (Tokyo University of Science)

A periodically forced Izhikevich neuron model with parameters of low-threshold spiking is analyzed from the viewpoint of interspike intervals (ISIs). Evaluation focusing on the diversity of ISIs clarified that periodic forcing induces both periodic and irregular responses and that possible phase transition occurs.

3AM1-1-4 Performance evaluation of chaotic search with stochastic solution transitions for various types of Electric Vehicle Routing Problems with Time Windows

Proc. pp. 442–445

Jun Adachi (Nippon Institute of Technology), Takafumi Matsuura (Nippon Institute of Technology), Takayuki Kimura (Nippon Institute of Technology)

The Chaotic Search (CS) method that employs Exchange and Relocate as the methods for generating neighborhood solutions has already been proposed to solve the Electric Vehicle Routing Problem with Time Windows (EVRPTW), and the CS method showed better solving performance than Tabu Search method. In this work, we introduced the stochastic solution search procedure into the CS method to enhance diverse searching performance. We then evaluated the performance of the proposed method for the EVRPTW benchmark problems in which customers are clusteringly and randomly placed. These benchmark problems are more difficult than the ones where the customers are clusteringly placed. From the numerical experiment, we confirmed that our proposed method successfully reduced the number of EVs compared to the CS method for difficult benchmark problems.

3AM1-2: Artificial Intelligence and Machine Learning for Image Processing

Date: 2 March, 11:00am to 1:00pm

Room: PAKALANA & ANTHURIUM

Chair: Gengtao Lin (Keio University)

3AM1-2-1 RGB-FIR object detection considering camera-to-camera misalignment

Proc. pp. 446–449

Masaya Hojyo (Ritsumeikan university), Masato Okuda (Ritsumeikan university), Kota Yoshida (Ritsumeikan university), Takeshi Fujino (Ritsumeikan university)

Object detection technology using deep neural networks is widely spreading such as advanced driver assistance systems (ADAS) that recognize the surrounding environment using images captured by cameras mounted on vehicles. ADAS normally use visible light (RGB) cameras and sometimes far-infrared (FIR) cameras are additionally used night-time. The reason is, RGB cameras are better with sufficient ambient light and FIR cameras are superior with low ambient light. Multispectral object detection using RGB and FIR images is expected to achieve robust performance against

various ambient light situations. YOLOv3 is one of the state-of-the-art image object detection techniques using DNN and it has also been reported on tasks with RGB-FIR images by using KAIST-Dataset. The dataset consists of RGB and FIR images taken by a special device that has the unified optical axis of RGB and FIR cameras and is calibrated for achieving the same angle of view and resolution of the images. However, the RGB camera is typically deployed inside the windshield but the FIR camera is needed to be deployed outside the car because the far-infrared rays do not penetrate glass. Thus, it is required to consider the misalignment between RGB-FIR images caused by the differences in the camera deployment positions. In this paper, we evaluate object detection using our own RGB-FIR dataset that has a misalignment between RGB and FIR images. First, we trained the "RGB-model" in which the model receives only RGB images. Second, we trained the "FIR-model" in which the model receives only FIR images. Third, we trained the "RGB-FIR model w/ alignment" in which the model receives aligned RGB-FIR images. By introducing the additional software preprocessing, note that the model assumes the case that the car equips a special camera system such as the one used in the KAIST dataset used in the previous study. Finally, we trained the "RGB-FIR model w/o alignment" in which the model receives RGB-FIR images including misalignment. Note that the images were labelled based on the coordinates of the RGB image. We expect that the model predicts object position based on RGB image while misaligned FIR image is used. We also expect that the third and fourth model achieves similar performance when the YOLO allow misalignment. Our experimental results show that the combination of RGB and FIR images improves the performance of object detection in both of day and night. In addition, the performance was almost unchanged by aligning at preprocessing, it indicates that YOLO can absorb misalignment.

3AM1-2-2 Improving Robustness of Adversarial Examples Generated by Fault Injection Attack on MIPI

Proc. pp. 450–453

Tatsuya Oyama (Ritsumeikan University), Kota Yoshida (Ritsumeikan University), Shunsuke Okura (Ritsumeikan University), Takeshi Fujino (Ritsumeikan University)

Adversarial examples (AEs), which cause misclassification by adding perturbations to input images, have been proposed as an attack method on image classification systems using deep neural networks (DNNs). Physical AEs have been proposed as realistic threats in the physical world, and it has been demonstrated that traffic sign boards with specific stickers are misclassified. As another approach to AEs in the physical world, we proposed a method of creating AEs using the fault injection attack on the Mobile Industry Processor Interface (MIPI), which is an image sensor interface. However, if the distance or position of the image is varied, tampering will

not be effective as AEs. In this paper, we generated robust AEs that cause misclassification of images with varying positions and distances by adding a common perturbation. Moreover, we propose a method to reduce the amount of robust AEs perturbation. Our results demonstrated successful misclassification of the captured image with a high attack success rate even if the position and distance are changed.

3AM1-2-3 Bit-Depth limited Demosaicking using Predictive Filter Flow

Proc. pp. 454–457

Daiki Arai (Tamagawa University), Taishi Iriyama (Saitama University), Masatoshi Sato (Tamagawa University), Hisashi Aomori (Chukyo University), Tsuyoshi Otake (Tamagawa University)

To reconstruct a high quality color image from bit-limited color filter array (CFA) data, bit-depth enhancement and demosaicking are required. The bit-depth enhancement is the technique to recover the high bit-depth (HBD) image from the low bit-depth (LBD) image. And the demosaicking is an image reconstruction process for restoring full-color images from CFA data. Although bit-depth enhancement and demosaicking have been relatively well studied and better optimized, respectively, the combination of demosaicking and bit-depth enhancement has not yet been fully and systematically explored. In recent years, deep convolutional neural network (CNN) techniques have provided excellent performance in many image processing tasks such as super-resolution, classification, deblurring, and denoising. In this paper, we propose a high quality color image reconstruction from bit-limited (low bit-depth CFA) data using Predictive Filter Flow (PFF). The PFF predicts a spatially variable filter using the CNN and reconstructs the target image by filtering it with the input image. We designed a filter to efficiently remove various noises caused by both demosaicking and bit-depth enhancement. Experimental results demonstrate that the proposed method is capable of reconstructing high quality color images from bit-limited CFA data.

3AM1-2-4 Cross-modal image-to-text retrieval with self-supervised contrastive learning

Proc. pp. 458–461

Yusuke Kato (Gifu University), Satoshi Tamura (Gifu University)

Cross-modal image-to-text retrieval tasks have been widely studied in recent years. Many retrieval methods maps images and texts into a common embedding space and measures their similarity. However, this strategy cannot take into account similar text other than the image and paired text when calculating similarity. We propose a high-performance crossmodal retrieval system with better retrieval results by introducing self supervised contrastive learning to consider

not only images and paired texts, but also texts that are similar to them. In addition, we also utilize category information. To validate the proposed method, we conducted experiments using Rakuten Recipe data, containing food image and text-based food recipes, which include title, instructions, and ingredients. We finally found that the retrieval results can be improved, with confirming the effectiveness of the functions introduced.

3AM1-2-5 Zero-shot evaluation index based on robustness of CNN output

Proc. pp. 462–465

Chisato Takahashi (Tokyo City University), Kenya Jin'no (Tokyo City University)

Neural Architecture Search (NAS), which aims to automatically optimize the structure in order to search for neural networks with excellent classification performance, has attracted much attention in recent years. Recently, zero-shot evaluation methods have been proposed to estimate classification performance without training in order to reduce search time. However, these indices are still insufficient for finding the best-performing neural networks. In this study, we confirm whether it is possible to evaluate CNNs using the robustness of the ReLU output distribution to weights. We propose a new zero-shot CNN evaluation index based on this robustness index.

3AM1-2-6 A Study of the Role of Latent Variables Using Three-Dimensional Shapes

Proc. pp. 466–469

Saki Okamoto (Tokyo City University), Kenya Jin'no (Tokyo City University)

We have focused on skip connections in the model and have experimentally tested the role of latent variables to clarify their role. The latent variables conveyed by the skip connection are named latent1, latent2, latent3, and latent4 in order from the shallowest layer. The results suggest that in the former case, latent1 extracts the information necessary to generate the image, while latent2 extracts the information that identifies whether the image is background or not. In the latter case, it is assumed that latent1 extracts low-frequency components of the input image, latent2 extracts high-frequency components and rotation information of the input image, and latent3 and latent4 extract information to improve image quality. In this paper, we consider a theoretical way to show this and proceed to examine the role of latent variables in the case where the images given to the input and output images are the same and different.

3PM1-1: IoT Applications

Date: 1 March, 2:00pm to 3:40pm

Room: PLUMERIA

Chair: Naoki Wakamiya (Osaka University)

3PM1-1-1 COLLABORATIVE LEARNING SUPPORT ENVIRONMENT UTILIZING GRAPH DOCUMENTS

Proc. pp. 470–473

Kenichi Shibata (RIKEN AIP), Shuichi Aono (Tamagawa University)

Graph documents that are superior in terms of 'flexibility of information representation', 'information analysis', and 'visualization' have been shown to help support online learning in recent years. This study focuses on recurrent education that working people continue to learn throughout their lives after leaving school. We evaluated the effectiveness of graph documents in such a learning environment. We constructed an online learning environment that combines a tool to support the collaborative creation of graph documents and a web conferencing service for creating graph documents and conducting collaborative learning online. As a trial, we conducted a demonstration evaluation at a learning site for recurrent education. The results showed that using graph documents for online group work was more effective than text documents in improving the quality of discussions.

3PM1-1-2 Composing an IoT platform using AWS - environment measurement of laboratory and student attendance management -

Proc. pp. 474–477

Yutaro Takada (Kanagawa Institute of Technology), Kazuki Odagiri (Kanagawa Institute of Technology), Ryusei Okamura (Kanagawa Institute of Technology), Kohki Akashi (Kanagawa Institute of Technology), Hiroshi Tanaka (Kanagawa Institute of Technology), Yasuhiro Sudo (Kanagawa Institute of Technology)

This paper presents the constructing of an IoT platform using AWS. The selected example for this study target is to measurement, collection, and monitoring system for an environmental data of our university laboratory. Moreover, an automatic presence judgment function using a Bluetooth device has been added to the student attendance management system. The objective of this work is to deploy this IoT server system throughout the university in the future. Consequently, everyone can connect various devices to this cloud network without any special knowledge or skills, and it will be able to experience IoTs. The interface is designed so that these parameter changes can be confirmed from a web browser. In the experiment, it was found that in poorly ventilated rooms, the CO₂ concentration exceed the reference level in a short period of time, depending on the number of people in the

room. And also, it was revealed that not only the lighting but also the lighting device from the windows unexpectedly affects the good illuminance. Regarding the automatic judgment of student entering and leaving the room, it was able to reliably identify the presence of Bluetooth devices, even in a fairly large room, and keep an accurate record.

3PM1-1-3 Dynamic Visualization of Basic High-Order Functions for Learning Functional Programming

Proc. pp. 478–481

Hidekazu Shiozawa (Tamagawa University), Takumi Shimura (Tamagawa University), Koki Asakawa (Tamagawa University), Takafumi Tanaka (Tamagawa University)

Functional programming is a paradigm of computer programming that composes a program with functions without side effects like mathematical functions. While it has the advantage of affinity for describing parallel processing, large-scale numerical computation, signal processing, and so on, it is considered difficult for even programmers to learn functional programming because of its high level of abstraction. In recent years, however, many programming languages have begun to incorporate basic functional features. We are developing a visual learning system for novice programmers of functional programming. This paper proposes a new method for dynamically visualizing the behavior of the most useful basic higher-order functions including lazy evaluation, and reports on an implemented prototype visualization system. In this method, a function is represented as a horizontal line segment instead of a node or a box, and function evaluation is represented as moving arguments down over the line segment instead of static line connections between nodes.

3PM1-1-4 Supporting Participants' Synchronized Hand Gestures on a Video Conferencing System

Proc. pp. 482–485

Kan Oyama (Graduate School of Engineering Tamagawa University), Hidekazu Shiozawa (College of Engineering Tamagawa University)

Online video conferencing is becoming dramatically popular in these recent years and is used in various situations such as business meetings and remote education. However, it significantly decreases non-verbal information compared to face-to-face discussions. Usually, this causes problems such as insufficient quality of communication and participants' mental stress, in particular when they are not regularly acquainted with one another in person. To deal with this problem, we propose a video conferencing system that visually supports interactive synchronized gestures in which multiple participants synchronize their actions remotely. We think that such a system can be useful for icebreakers, group work in education, and casual meetings. This paper reports

the implementation of a interactive gesture: high five, and the evaluation of usability and realistic feeling of these functions.

3PM1-1-5 Feasibility Study of Daily-activity Recognition Using Compressed Sensing

Proc. pp. 486–489

Shion OTA (Ritsumeikan University), Tomohiro FUJITA (Ritsumeikan University)

Daily-activities recognition using wearable device sensors has been performed. We used the activity recognition method proposed by Akl et al. using compressed sensing. This method has so far been applied only to simple gesture recognition. Therefore, in this study, we evaluated whether more complicated activities can be applied. In this method, the compressed sensor signal of the wearable device is restored using Lasso, and activity recognition is performed from the restored result. We extracted exemplars from training data by affinity propagation and created a dictionary matrix for compressed sensing. We used the Human Activity Recognition Using Smartphones Dataset for evaluation. Based on the evaluation results, the F-measure was 51.3%, and this value is judged to be insufficient for practical activity recognition. We infer that the cause of the insufficient results was noise in the sensor signals contained in the dataset.

3PM1-2: Biomedical Signal Processing

Date: 1 March, 2:00pm to 3:40pm

Room: PAKALANA & ANTHURIUM

Chair: Yukihiro Nomura (Chiba University)

3PM1-2-1 Identification of sexually dimorphic effect of oxytocin intranasal administration on B6J mice electroencephalography

Proc. pp. 490–493

Clarissa Genevieve Gregory (Keio University), Yasue Mitsukura (Keio University)

The present study focuses on the effects of intranasal oxytocin administration on mice electroencephalogram recordings. Oxytocin is the neuropeptide gathering attention for its investment in social behaviors, development, and brain functions. Since this neuropeptide is highly invested in reproduction and parturition it may have different effects depending on the sex of the individual. Hence it is crucial to assess the differences in effect. We use a signal processing and statistical approach on mice electroencephalograms to compare the effects on male and female mice. We found several significant differences between each sex as. However,

our capacity to draw conclusions is limited by the high individual variability of effects we observed in experimental subjects.

3PM1-2-2 Prefrontal Power Asymmetry Feature Extraction for Depression Severity in a Clinical Study

Proc. pp. 494–497

Gengtao Lin (Keio University), Yasue Mitsukura (Keio University)

Major depressive disorder (MDD) has major impacts around the globe, and it's becoming a serious public health issue. Electroencephalography (EEG) has been proven to be an effective tool to retrieve brain signals, but EEG biomarkers were inadequately explored under actual clinical settings due to difficulties in recordings and varieties of signal features. This study purposed a novel signal processing approach to decompose EEG signals into individual frequencies, presenting a preliminary exploration of cortical asymmetry features and their interactions with depression severity and medications. We recorded 30 depressed patients as they actively engaged in clinical assessments using a bipolar EEG and compared them to 30 healthy controls. Prefrontal asymmetries were computed from power spectral density at individual frequencies. The analyses compared differences between patients and controls, as well as differences between patients with different severity and different medical prescriptions. We observed significant differences in power asymmetries spanned across frequencies within theta, alpha, and beta regions between depressed patients and healthy controls, as well as between severity subgroups, especially for the mild and moderate depression groups. Further inspections were needed to demonstrate a relation between severity and medication usage. The study showed a potential that the paradigm is feasible in clinical practices.

3PM1-2-3 Separation of Masticatory and Swallowing Sounds Using Wavelet Analysis

Proc. pp. 498–501

Yuto Yamamura (Toyo University), Yutaka Suzuki (Toyo University), Nobuyuki Terada (Toyo University), Shuya Shida (Toyo University)

Evaluation of swallowing function by swallowing sounds for prevention of aspiration pneumonia has been reported previously; however, the distinction between masticatory and swallowing sounds has not been studied. Therefore, this study aimed at distinguishing between mastication and swallowing based on the sounds produced during feeding movements. Daubechies wavelet analysis of the sounds made during feeding on samples of almonds and white rice of different hardness and viscosity has been performed. The analysis showed that the intensity of mastication sounds changed from low to high scale in a shorter time span, while

the intensity of swallowing sounds changed from high to low scale in a longer time span. improve comfort within car interiors.

3PM1-2-4 EEG Current Source Localization Using Deep Prior

Proc. pp. 502–505

Naoki Hojo (Kobe University), Hajime Yano (Kobe University), Ryoichi Takashima (Kobe University), Tetsuya Takiguchi (Kobe University), Seiji Nakagawa (Chiba University)

The estimation of current sources in the brain from magnetoencephalogram (MEG) or electroencephalogram (EEG) is generally an underdetermined problem. Many conventional methods uniquely estimate the current source by explicitly assigning a prior distribution of current sources. In our previous work, we proposed a method for solving the MEG inverse problem using an implicit prior of an untrained convolutional neural network (CNN), which is called Deep Prior, and showed that the CNNs can represent the prior distribution of current sources. However, MEG measurement requires large-scale equipment and it is desirable to estimate the current source from EEGs, which can be measured more easily. In this paper, we propose a method to estimate current sources from EEGs using Deep Prior, and show that it is more accurate than the conventional methods. We also show that linearizing the network structure improves the localization accuracy.

3PM1-2-5 Effect of Frequency Bands of Vehicle Sound Components on Attentional Mechanisms Using Event-Related Potentials

Proc. pp. 506–509

Yuki Kameyama (Hiroshima City University), Shunsuke Ishimitsu (Hiroshima City University), Keisuke Kotaka (TOYOBO CO. LTD.), Yasuto Fujii (TOYOBO CO. LTD.)

In recent years, with the spread of electric vehicles, impressions of the sound of automobiles have changed. As automated driving becomes more widespread, we assume that a decrease in cognitive load will make it easier for drivers to pay attention to vehicle sounds, thereby increasing their discomfort. This study focused on selective attention and aimed to quantify the attentional mechanisms of vehicle sounds from event-related potentials (ERPs). In addition, it is necessary to identify the characteristics of vehicle sounds that attract attention and awareness more easily, reduce unwanted vehicle sounds, and make them more pleasant from a neurophysiological perspective. In this study, an experiment was conducted to measure brain responses while driving to identify the characteristics of sounds that are likely to attract attention, by observing changes in ERPs for different frequency bands. These results may help investigators examine practical approaches to reduce vehicle sounds and

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