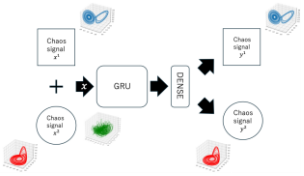
GS Abstract
GS1 Machine Learning I (4)

GS1-1 Development of functional differentiation in recurrent neural networks by mutual information regulation

Yuki Tomoda, Yutaka Yamaguti (Fukuoka Institute of Technology, Japan)

Functional differentiation is the process by which different brain areas become specialized for specific functions. We propose a novel method that induces functionally differentiated structures in recurrent neural networks by minimizing mutual information between neural subgroups. The RNN was trained to separate two superimposed chaotic signals. We found that dynamical modularity emerged earlier and more prominently than anatomical modularity. Functionally differentiated networks exhibited increased resistance to input noise, while responses to neuron damage showed qualitative changes in network dynamics. These findings suggest that mutual information minimization promotes both functional specialization and robustness.



GS1-2 A Deep Learning-Based Shopping Support Method for a Visually Impaired Person

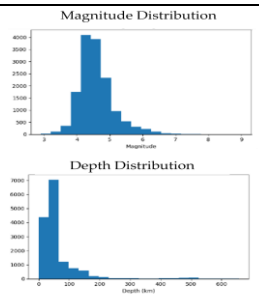
Takaya Yamaguchi, Seiji Ishikawa, Yui Tanjo (Kyushu Institute of Technology, Japan)

Shopping is one of the most important but challenging activities for a visually impaired people. This paper proposes a method to help them find convenience stores and their entrances based on deep learning using the images provided from a camera mounted on the chest of a user. This paper focuses on convenience stores because they have variety of goods and nationwide coverage. The proposed method employs a transfer learning model to recognize and detect the position of a convenience store, its signboards and logos, entrances of the store, and obstacles such as vehicles parked in front of the store. Then the method gives directional instructions to the user with a voice-function based on the detected store location to guide them going into a target store. Experimental results under real environments show effectiveness of the proposed method.

GS1-3 Spatial-Temporal Analysis of Earthquakes for Urban Resilience Using Machine Learning

Adessarman Muhammad Sahlan[1], Bart Dewancker[1], Mohammad Albaroudi[2], Raji Alahmad[2],
Fahd Moumni[2,3], Ornella Okogo [4]
([1]The University of Kitakyushu, Japan) ([2]Kyushu Institute of Technology, Japan) ([3]MicroOrbiter Inc, Japan)
([4]Engineering School of the City of Paris, EIVP, France)

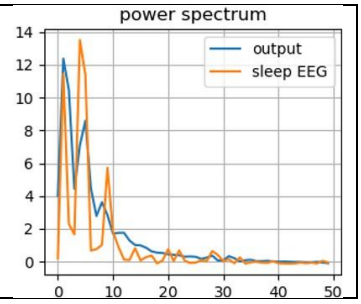
Understanding how and where earthquakes occur helps build safer and more resilient cities. This study analyzed nearly fifty years of earthquake data from Russia's Kamchatka region using machine learning techniques. By applying clustering algorithms, clear seismic hotspots emerged along major fault lines, showing that most earthquakes were shallow and highly threatening to urban areas. The classification models reached 85% accuracy in identifying high-risk zones, highlighting that cluster density and time-based activity are strong predictors of seismic hazards. These findings show that reliable earthquake risk assessments can be achieved using historical records. The results contribute to developing smarter disaster preparedness and safer urban planning in earthquake-prone regions.



GS1-4 Modeling Sleep-Stage Transitions in EEG with a Recurrent Neural Network

Nikolas Acquaviva, Yutaka Yamaguti (Fukuoka Institute of Technology, Japan)

This work aims to train a recurrent neural network to generate signals that replicate the frequency characteristics of sleep EEG. The input to the network represents the current sleep stage of the EEG. For training, EEG data including sleep state transitions is used as the target, and the loss function is defined as the difference between the power spectrum of the sleep EEG and the power spectrum of the output signal. This research may provide important clues to the dynamical mechanisms underlying the rhythmic activity of brain waves during sleep.

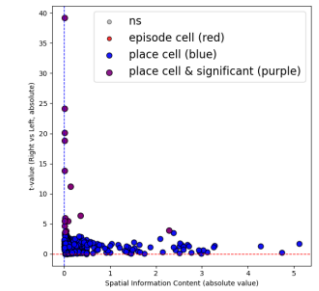


GS2 Machine Learning II (4)
Chair

GS2-1 Formation of Place and Episodic Memory in a Recurrent Neural Network

Shin Tamura, Yutaka Yamaguti (Fukuoka Institute of Technology, Japan)

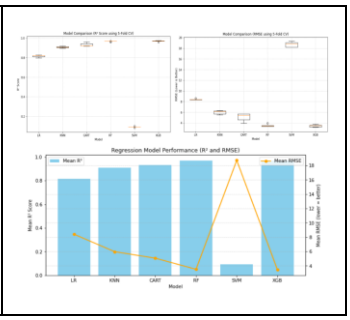
The hippocampus is a key brain region involved in spatial and episodic memory. In this study, we employed a recurrent neural network (RNN) model to reproduce rat experiments that recorded hippocampal activity related to episodic-like memory, aiming to explore its underlying functions and mechanisms. The RNN was trained to perform a spatial alternation task with navigation, selecting actions based not only on current sensory input but also on past behavioral history. Analysis of neural activity revealed place field–like and episode-like neurons, exhibiting spatially specific and memory-dependent firing, respectively.



GS2-2 A Systematic Comparison of Machine Learning Models for State of Charge Estimation in CubeSat Lithium-ion Battery System

Babu Vishwanath Hemath Kumar*, Kitamura Kentaro, Necmi Cihan Orger, Kei Sano
(Kyushu Institute of Technology, Japan)

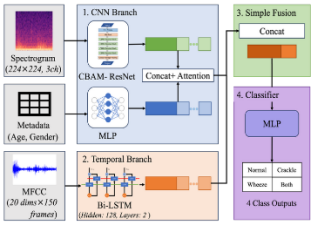
This paper presents a data-driven machine learning approach for SOC estimation of the Engineering Model (EM) battery pack designed for VERTECS mission. A SOC-open circuit voltage curve was derived to characterize the equilibrium voltage-charge relationship, and the long-duration charge-discharge data were collected under nanosatellite operational conditions. A unified experimental framework was implemented to systematically compare multiple algorithms, highlighting the superior performance of Random Forest (R-square = 0.967, RMSE=3.358%) and Extreme Gradient Boosting (R-square = 0.975, RMSE = 3.54%) without hyperparameter tuning. The results demonstrate that machine learning approach enables accurate and adaptable SOC prediction for mission-critical nanosatellite applications.



GS2-3 AuscuFuse: A Robust Parallel Dual-Branch Network for Respiratory Sound Classification

Ryusei Oshima, Tohru Kamiya
(Kyushu Institute of Technology, Japan)

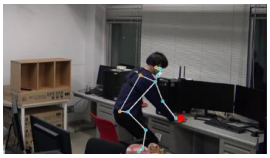
Although respiratory sounds are crucial for non-invasive diagnoses, interpreting them remains subjective. We propose AuscuFuse, a multimodal deep learning model integrates spectrograms, Mel-Frequency Cepstral Coefficients (MFCCs), and patient metadata. Unlike complex serial architecture, our model employs robust, parallel, dual-branch architecture. We evaluated the model using the ICBHI 2017 dataset and compared a streamlined fusion strategy with variants employed Temporal Gating and Multi-Head classifiers. Contrary to expectations, the simplest parallel fusion achieved the highest ICBHI score (0.816), outperforming the complex variants. These results demonstrate that, for limited data sets, minimizing architectural complexity prevents overfitting and that simple parallel integration provides the most robust performance.



GS2-4 A Method of Objects Remembrance Support Based on Object-Holding Action and Its Recognition

Taisei Shiraki, Seiji Ishikawa, Yui Tanjo (Kyushu Institute of Technology, Japan)

In a human daily life, the stress associated with searching for misplaced items cannot be ignored for his/her mental health. This paper proposes a computer vision system which records the locations of a user's belongings and assists the user in finding lost items indoors, utilizing a wearable camera attached on the user's arm and a camera of an indoor robot. The proposed method consists of the detection of an object-holding action using a deep distance learning model and the recognition of the held object employing a conversational tagging process. These two processes enable the proposed system to acquire personalized object recognition and managing capabilities leading to leveraging a user's everyday action of finding and carrying items. It realizes a personal support system of object location recall. Experimental results show effectiveness of the proposed system.



GS3 Autonomous Driving & Aircrift (5)
Chair

GS3-1 Map-Based Navigation and Localization in the Autoware Simulator Using Integrated Open-Street-Map and Point-Cloud-Data

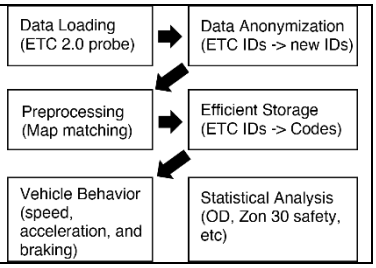
Obada Al Aama[1], Tomoki Taniguchi[1], Davaanyam Jargal[1], Hodaka Inoue[1], Junya Oishi[2], Wataru Mizushina[2], Hakaru Tamukoh[1], Hiroaki Wagatsuma[1]
([1]Kyushu Institute of Technology, Japan, [2]Aisan Technology Co., Ltd., Japan)

This paper introduces a simulation-oriented framework that leverages the Autoware simulator to assess autonomous vehicle navigation and localization. The approach fuses Open-Street-Map (OSM) data with Point-Cloud-Data (PCD) to generate realistic digital road environments. OSM supplies large-scale roadway structure, while PCD refines geometric detail to create high-fidelity maps. The integrated maps support testing of localization, path planning, and vehicle control under diverse scenarios. The framework enables configurable conditions to assess performance and robustness prior to on-road validation. Through integration of semantic map content with precise 3D sensing data, this approach offers an efficient platform for developing and validating autonomous driving technologies.

GS3-2 A Python-Based Framework for Preprocessing and Vehicle Flow Analysis of ETC2.0 Probe Data for Efficient Data Handling

Rena Kato[1], Souma Noguchi[1], Ahmad Altaweel[1], Haruki Sato[1], Guanyu Su[1], and Hiroaki Wagatsuma[1]
([1]Kyushu Institute of Technology, Japan)

This study presents a preliminary Python-based framework for efficient data processing and analysis of ETC2.0 probe data. The framework enables streamlined handling of large-scale traffic datasets and supports vehicle-level identification with an origin–destination specification, useful for analyzing the mechanisms of traffic jam formation and Zone 30 safety near schools. Designing for flexible adaptation to target regions and historical periods, it provides a reproducible and open workflow to facilitate future research on traffic flow and ITS applications.



GS3-3 Development of a Bird-Inspired Flapping-Wing Robot Capable of Bounding Flight

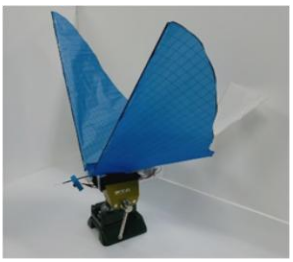
Kanato Matsui, Hiroshi Ohtake (Kyushu Institute of Technology, Japan)

In recent years, unmanned aerial vehicles (UAVs) have been widely used in various fields such as agriculture, disaster response, and meteorological observation. Among various UAV types, flapping-wing UAVs can generate both lift and thrust by flapping their wings like birds, enabling diverse flight modes. However, they suffer from short operating time due to high energy consumption. This study focuses on *bounding flight*, a characteristic flight mode of passerine birds. In bounding flight, birds flap their wings several times to gain upward momentum and then fold them to perform ballistic gliding, thereby achieving higher energy efficiency. In this study, a flapping-wing robot with foldable wings was developed, and its flight performance was evaluated using a six-axis force sensor and flight experiments. The goal is to achieve both sustained flight and bounding flight, which may help overcome one of the main limitations of flapping-wing UAVs.

GS3-4 A Study on Image Processing and Tracking Control of a Small Flapping Flight Robot with a Camera

Shuto Wakugawa, Hiroshi Ohtake (Kyushu Institute of Technology, Japan)

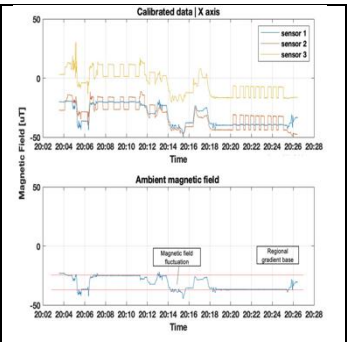
In this study, we developed a system for a small flapping-wing robot, which mimics bird flight and is designed to address noise and safety issues associated with drones, to enable object tracking. The robot is equipped with a camera and was implemented using an external laptop PC and OpenCV to detect the position of a target object in the camera coordinate system. Based on the detected position, control signals are generated in real-time to adjust the left and right flapping angles of the wings. Experiments confirmed that the system can accurately recognize the target's position and modulate wing motion accordingly. Although full tracking flight has not yet been achieved, these results demonstrate the feasibility of vision-based feedback control for flapping-wing robots and indicate potential for future autonomous object-tracking flight. The next step is to implement real-time tracking control during actual flight.



GS3-5 Separation of Stray Magnetic Fields in 3U CubeSats Using Multiple Magnetometers and Blind Source Seperation method

Enkhmend Ochirsukh[1], Kitamura Kentaro[2], Necmi Cihan Orger[2] (Kyushu Institute of Technology, Japan)

Spacecraft instruments often create unwanted magnetic noise that distorts onboard measurements. To tackle this, the Leopard 3U CubeSat introduces a compact, low-cost solution using multiple COTS magnetometers and Blind Source Separation.
Three magneto-impedance sensors mounted on its panels detect and isolate stray fields, while Independent Component Analysis (ICA) separates ambient and artificial signals. Ground experiments confirm the method's accuracy, offering a promising path toward cleaner, more reliable geomagnetic data for future CubeSat missions.

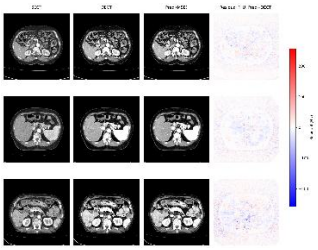


GS4 Image Processing I (8)
Chair

GS4-1 Evaluation of Virtual Monoenergetic X-ray Image Conversion Using U-Net

Taiga Tanimoto[1], Naohiro Iwata[1], Yohei Kamikawa[1], Shogo Baba[2], Yukito Yoshida[1]
([1] Oita University Hospital, Japan), ([2] Seinan Gakuin University, Japan)

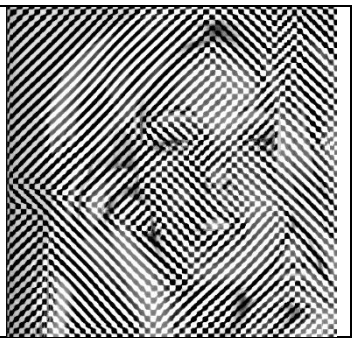
Dual-energy CT (DECT) enhances contrast by generating virtual monoenergetic images (VMI), but its use is limited by high cost and availability. This study developed a deep learning model to reconstruct MonoE 40 keV images from single-energy CT (SECT). Abdominal SECT images from a Philips Spectral CT 7500 were used to train a U-Net with mean squared error (MSE) loss. Image quality was evaluated using PSNR, SSIM, MAE, and CNR, along with residual analysis. The reconstructed images showed superior performance to SECT input, with CNR increasing about 2.5-fold. Residual analysis revealed minimal errors without structural artifacts. These results demonstrate that U-Net with MSE loss enables high-fidelity SECT-to-MonoE conversion and may provide a cost-efficient alternative to DECT for clinical practice.



GS4-2 Generation of Stripe-Patchwork Images by Selecting from Horizontal and Vertical Averages

Jia-Lin Zhang, Toru Hiraoka (University of Nagasaki, Japan)

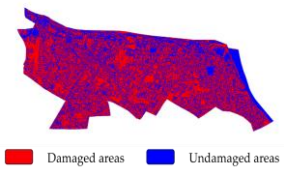
This paper proposes a method to generate stripe-patchwork images composed of more linear stripe-patchwork patterns than stripe-patchwork images of the conventional methods. Additionally, the outside of stripe-patchwork patterns of the proposed method is expressed by waviness. The proposed method is executed by repeating two processes: the first process is to smooth photographic images by selecting from horizontal and vertical averages according to the position of photographic images, and the second process is to restore the smoothing images using inverse filter. To verify the effectiveness of the proposed method, experiments were conducted to apply the proposed method to various photographic images.



GS4-3 Edge-Based Image Processing for Urban Change Detection after Earthquakes

Adessarman Muhammad Sahlan[1], Bart Dewancker[1], Mohammad Albaroudi[2], Raji Alahmad[2], Fahd Moumni[2,3], Karim Hasibuan[2]
([1]The University of Kitakyushu, Japan) ([2]Kyushu Institute of Technology, Japan) ([3]MicroOrbiter Inc, Japan)

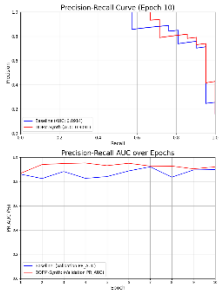
Rapid assessment after earthquakes is vital to save lives and guide recovery efforts. This study presents an image-based approach for detecting urban damage using satellite data. By applying Canny edge detection and K-means clustering, changes in building boundaries and city layouts before and after earthquakes can be clearly identified. The method highlights collapsed structures and debris zones with enhanced visual clarity. Tested on Palu, Indonesia, earthquake imagery, it detected 57.99% of damaged areas with strong accuracy and efficient computation. The results demonstrate the potential of fast, data-driven mapping to support emergency response teams with real-time spatial insights. Beyond immediate relief, this approach can also inform safer urban planning and disaster resilience in the future.



GS4-4 Diffusion-Based Data Augmentation Mitigates Class Imbalance in Circulating Tumor Cell Fluorescence

Kouki Tsuji[1], Kazue Yoneda[23], Tohru Kamiya[1]
([1]Kyusyu Institute of Technology, [2]Hyogo Medical University, [3]University of Occupational and Environmental Health, Japan)

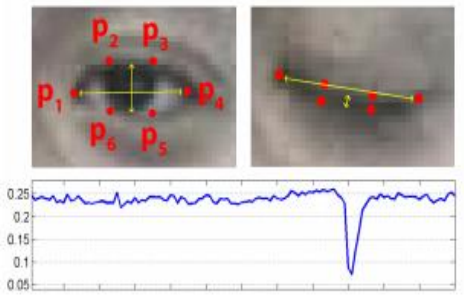
Circulating tumor cells (CTCs) are rare, making fluorescence microscopy screening labor-intensive. Automatic detection systems to help pathologists struggle with severe class imbalance between abundant normal cells and scarce CTCs. To address this challenge, we introduce denoising diffusion probabilistic model (DDPM) augmentation to synthesize realistic CTC images. Adding ~30% DDPM-generated CTCs to InceptionV3 fine-tuning improves validation PR AUC from 0.933 to 0.941 and ROC AUC from 0.978 to 0.985 while maintaining ~95% accuracy, indicating better minority-class ranking without overfitting. These results show that diffusion-based augmentation is a practical strategy for robust, computer-assisted CTC screening under extreme imbalance.



GS4-5 Estimating Driver Drowsiness Using Millimeter-Wave Radar

Yoshikazu Hirayama, Kazuya Matsuo (Kyushu Institute of Technology, Japan)

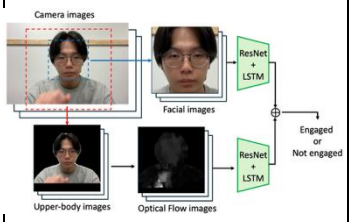
This study proposes a non-contact drowsiness estimation method combining camera-based blink detection and millimeter-wave radar-based heartbeat measurement. While conventional camera methods suffer from low accuracy in dark or occluded environments, the integration of radar sensing enables stable monitoring under various conditions. The system calculates the Eye Aspect Ratio (EAR) from facial images to detect blinks and acquires heartbeat signals using a millimeter-wave radar to extract physiological features. These multimodal data are integrated to estimate drowsiness levels. The proposed system has been implemented and is currently under experimental evaluation.



GS4-6 Engagement Estimation in E-Learning Using Facial and Upper-Body Videos

Shun Takeshita, Noriko Takemura (Kyushu Institute of Technology, Japan)

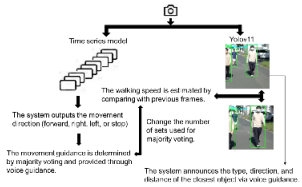
Online learning using video materials and web conferencing is widespread. However, indicators such as concentration and alertness are insufficient to capture learners' active engagement in the learning task. This study aims to estimate engagement using data collected during actual e-learning sessions. We developed a model that processes sequences of facial-region images and upper-body optical flow images, where features extracted by a ResNet and an LSTM are concatenated to estimate engagement. Evaluation experiments were conducted to compare estimation performance under different input configurations. The findings suggest that visual cues can contribute to engagement estimation and imply that incorporating multiple levels of bodily information may lead to more robust assessment.



GS4-7 Development of a Direction Indicating Navigation Method for a Visually Impaired Person

KenyuTakahashi, Yui Tanjo (Kyushu Institute of Technology, Japan)

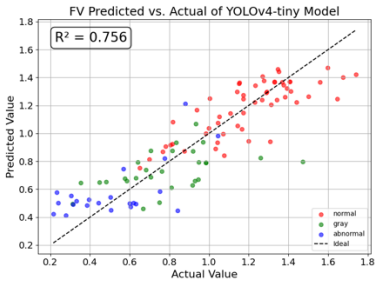
This paper proposes a wearable navigation method that provides short-term instructions on moving direction, *i.e.* forward, left, right, or stop, to a visually impaired person using a chest-mounted camera. The proposed method employs YOLOv11 to detect a pedestrian, Resnet to extract features of input images, and TimesNet to predict his/her moving direction. To stabilize the predicted direction, two rules are introduced, i.e., (i) a fixed majority-voting rule, and (ii) a speed-adaptive majority-voting rule based on the distance trajectory between the user and his/her nearest pedestrian. SORT tracking is also included in the method to prevent identity change when computing the nearest-pedestrian distance. The proposed method was evaluated by offline scenes and actual scenes under a real environment, and the results showed effectiveness of the method.



GS4-8 Two-Stage YOLOv4-Tiny for Vascular Stenosis Detection Using AVF Shunt Sound Data

Lucky Nindya Palupi, Hiroki Tamura
(Interdisciplinary Graduate School of Agriculture and Engineering, University of Miyazaki, Japan; Faculty of Engineering, University of Miyazaki, Japan)

This study presents a two-stage YOLOv4-tiny framework for identifying vascular stenosis in dialysis patients using arteriovenous fistula (AVF) shunt sound data. Shunt sounds were recorded with a digital stethoscope, stored as WAV files, and converted into spectrogram images for analysis. In the first stage, YOLOv4-tiny classified the spectrograms into normal and non-normal categories. In the second stage, the non-normal samples were further classified into gray and abnormal conditions. The first-stage model achieved an accuracy of 70.75%, while the three-class classification reached 67.92%. To evaluate the model's relevance to hemodynamic assessment, Support Vector Machine (SVM) regression was applied to estimate flow volume (FV), pulsatility index (PI), and resistance index (RI) using YOLO confidence scores. The resulting R^2 values for FV, PI, and RI were 0.756, 0.486, and 0.749, respectively. These findings indicate that the two-stage YOLOv4-tiny approach provides a promising non-invasive method for detecting vascular stenosis from AVF shunt sound data.

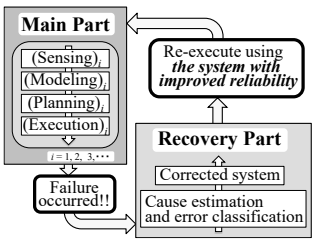


GS5 Robotics & AI (5)
Chair

GS5-1 Selection of Error Recovery Path Using Optimization of Evaluation Functions

Akira Nakamura[*1] and Kensuke Harada[*2]
([*1] Saitama Institute of Technology, [*2] Osaka University, Japan)

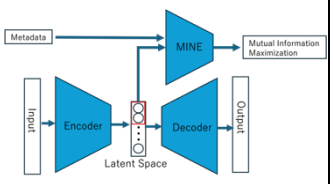
In recent years, intelligent robots have been applied not only in industry but also in various fields. In particular, robots that perform detailed tasks with precision, such as humanoid robots and medical robots, need to work safely and securely. Therefore, adaptability to errors and failures is becoming important. To address this issue, it is necessary to generalize and systematize error recovery techniques, and we have proposed a method that covers both forward recovery and backward recovery. Forward recovery is suitable for minor changes, while backward recovery is suitable for major failures. In this study, we present a new selection method to determine the optimal recovery path using evaluation functions.



GS5-2 Learning Interpretable Latent Representations from Single-Cell RNA-seq with VAE and Mutual Information

Tomohito Yamamura, Yutaka Yamaguti (Fukuoka Institute of Technology, Japan)

This paper applies a Variational Autoencoder (VAE) constrained by mutual information to analyze complex biological data. The VAE efficiently compresses high-dimensional gene expression data into a lower-dimensional latent space, but its latent variables are often difficult to interpret biologically. To address this issue, we propose a method that introduces a mutual information constraint into the VAE framework. This allows the model to learn representations that are more strongly associated with metadata accompanying the scRNA-seq data, such as temporal or experimental information. The proposed approach aims to improve the interpretability of latent features and contribute to a deeper understanding of underlying structures and dynamics from single-cell gene expression data.



GS5-3 Development of Outdoor Autonomous Driving Robots- Improvement of the Performance with Autonomous Driving

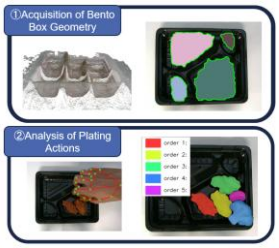
Kako Koyama, Yui Tanjo
(Kyushu Institute of Technology)

This paper proposes a safer system by integrating image-based self-localization techniques; drivable area estimation using RGB images and obstacle detection using depth images. The drivable area estimation method combines graph-based segmentation (GBS), U-net++-based road estimation, and correction using texture feature analysis. For obstacle detection, the ground and obstacle areas are extracted based on the normal information calculated. Safety scores for each direction are calculated from the estimated drivable area and detected obstacle and ground areas, determining the direction of advance toward the safer path. For global self-localization, checkpoint determination is performed through image comparison. Experimental results under outdoor autonomous drive show effectiveness of the proposed system.

GS5-4 Development of a Method of Automated Food Presentation

Ryosei Todo, Yui Tanjo (Kyushu Institute of Technology, Japan)

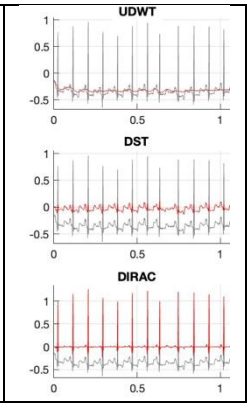
Existing food presentation robots simply repeat pre-registered paths that have been planned by an operator. This requires skilled operators to set parameters whenever new bento boxes or food items are introduced. This paper proposes a system that automatically extracts food presentation information from the worker's actions during food presentation. To realize this, a depth camera is used to acquire geometric features of a bento box from point-cloud data and extract each partition of the bento box by Knee detection algorithm. Media Pipe Hand and Segment Anything Model are also used to detect the worker's hand who is doing food presentation and segment each food from two successive images. From the segmented results, IOU and Resnet are introduced to match and decide the position of each segmented food in a bento box. The effectiveness of the proposed method is shown experimentally.



GS5-5 A Preliminary Study on Morphological Component Analysis for Arrhythmia Detection in ECG Signals from the MIT-BIH Arrhythmia Database

Faustine Faccin[1,3,4], Diunuge Buddhika Wijesinghe[2], Rena Kato[2], Kosei Shibata[2], Shabbir Mahmood[2], Hodaka Inoue[1], Pauline Guyot[4], Laurent Bougrain[3,5] and Hiroaki Wagatsuma[2] ([1]Université de Lorraine, CNRS, CRAN, France, [2]Kyushu Institute of Technology, Japan, [3]Université de Lorraine, CNRS, LORIA, France, [4]NOVIGA, France, [5]Sorbonne Université, Institut du Cerveau – Paris Brain Institute (ICM), France)

This study presents a preliminary explainable arrhythmia classification method using Morphological Component Analysis (MCA) and index thresholding applied to ECG signals. Cardiovascular disease remains a major global health issue, and while automated ECG analysis has advanced, data-driven AI methods often lack interpretability. We address this point by focusing on binary classification between normal beats and premature ventricular contractions using data from the MIT-BIH Arrhythmia Database. MCA decomposes ECG signals into morphological components through redundant transforms with UDWT, DST, and Dirac dictionaries. The Dirac component captures abrupt changes corresponding to the initiation of ECG cycles, while irregularities appear mainly in the UDWT component. Based on these features, an integrative classification method is proposed.

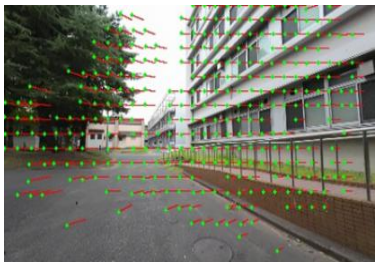


GS6 Applications I (6)
Chair

GS6-1 A Method of Recognizing Health Condition Based on Walking Patterns

Kanato Tajika, Seiji Ishikawa, Yui Tanjo (Kyushu Institute of Technology, Japan)

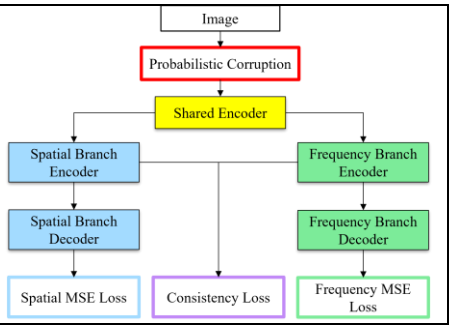
The percentage of the people who feel unhealthy tends to increase with age, highlighting the importance of early detection of physical abnormalities. This paper proposes a method of detecting changes in walking patterns that may indicate early signs of physical abnormalities using a camera attached to a human. This method records two elements, i.e., a walking path and a walking motion, and analyzes their normality by comparing it with a normal walking pattern. Change in either the walking path or the walking motion compared to the baseline is recognized as the change in walking pattern. This method is expected to enable the detection of changes in walking patterns, facilitating the early detection of changes in health status. Experimental results show the effectiveness of the proposed method.



GS6-2 Spatio-Frequency Consistency Learning for Self-Supervised Visual Representations

Zhongxi Zhang, Cunwei Lu (Fukuoka Institute of Technology, Japan)

This paper proposes a “Spatio-Frequency Consistency” learning framework to enrich self-supervised learning by integrating complementary information from both spatial and frequency domains. Our method features a dual-branch structure with a shared encoder. One branch reconstructs randomly masked spatial patches, while the other reconstructs masked discrete cosine transform coefficients. Furthermore, we introduce a consistency loss to align the feature representations from both branches. This integrated system, which leverages complementary information, is demonstrated to be highly effective and achieves superior performance compared to single-domain approaches on the ImageNet-1K dataset.



GS6-3 Experimental Comparison of Leather Rotational Torque in Vertical and Horizontal Hide-Tanning Techniques for Traditional Leather Processing in Mongolia

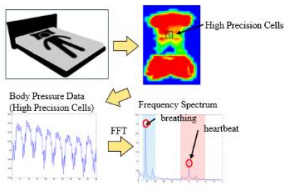
Renchinvanjil Yadam[1], and Dondogjamts Batbaatar[1]
([1]Mongolian University of Science and Technology, Mongolia)

This study experimentally examines the rotational torque of leather used in traditional Mongolian hide tanning. Building on previous research on leather mechanics, a torque measurement device was developed to compare vertical and horizontal setups under controlled conditions. Results show significant differences in torque requirements between orientations, affecting tanning efficiency and energy demand. These findings provide key data for improving ergonomic, energy-efficient hide-tanning equipment for rural use and form a foundation for integrating experimental validation into future design and modeling.

GS6-4 Method for determining the optimal pressure measurement site for heart rate monitoring using a flexible sheet-type tactile sensor

Kyota Suzuki, Kazuya Matsuo (Kyushu Institute of Technology, Japan)

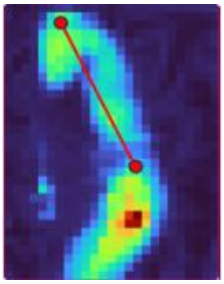
In recent years, severe labor shortages in nursing care have increased the need for labor-saving solutions. We have developed a system using flexible sheet-type tactile sensors on beds to non-invasively and continuously monitor care recipients' health conditions; however, heart rate measurement accuracy remains challenging. This study proposes a machine learning model that classifies sensor cells into three categories (successful, uncertain, unsuccessful) for heart rate measurement, using time- and frequency-domain features and local pressure distributions from body pressure waveforms.



GS6-5 Sleep Posture and Heartbeat Estimation Using a Flexible Tactile Sensor Sheet

Hibiki Shimono (Kyushu Institute of Technology, Japan)

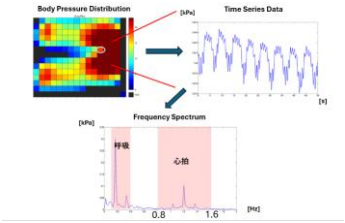
Sleep monitoring, including posture and vital sign measurement, is essential for evaluating sleep quality and health. Conventional methods require many sensors attached to the body, which are not suitable for daily use. We propose a non-invasive monitoring method using a flexible tactile sensor sheet placed on a bed. The sensor can simultaneously measure posture and biological signals such as heartbeat and respiration. A multitask model combining keypoint detection and classification is used to estimate posture and identify optimal regions for heartbeat measurement. Currently, we are generating simulation data using the SOFA Framework to analyze sensor performance. The final goal of this study is to clarify the relationship between sensor resolution and estimation accuracy for designing an optimal sensor configuration.



GS6-6 Heart Rate Measurement Using a Flexible Sheet-Type Tactile Sensor

Kamui Nagano (Kyushu Institute of Technology, Japan)

In recent years, nursing care facilities have faced severe labor shortages, increasing the need for technologies that reduce caregiver burden. This study aims to develop a system that measures heart rate simply by having a person sit on a chair equipped with flexible sheet-type tactile sensors installed on the seat and backrest. The system estimates heart rate from pressure fluctuations produced by subtle body movements associated with cardiac activity. By enabling non-contact and automatic monitoring, this approach can support continuous health observation in nursing environments. Implementing this system in care facilities is expected to significantly reduce caregivers' workload while improving monitoring efficiency.

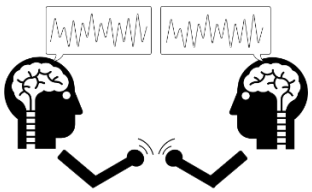


GS7 Applications II (6)
Chair

GS7-1 Dynamics of Inter-Brain Phase Synchronization During the Emergence of Coordinated Behavior

Rena Kato[1], Akio Wakata[1], Kosei Shibata[1], Shabbir Mahmood[1], Diunuge Buddhika Wijesinghe[1], Yide Yang[1], Masayuki Fujiwara[2], Laurent Bougrain[3], Kiyohisa Natsume[1], and Hiroaki Wagatsuma[1]
([1]Kyushu Institute of Technology, Japan, [2]Komatsu University, Japan, [3]University of Lorraine, France)

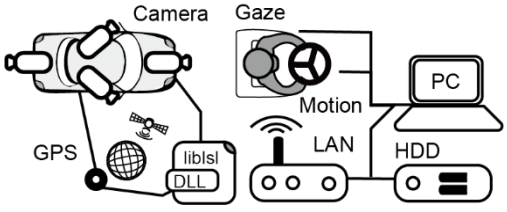
Understanding how neural synchronization emerges during coupled movements is crucial for elucidating interpersonal coordination dynamics. We investigate inter-brain phase synchronization as two individuals coordinate rhythmic arm movements across game phases. Simultaneous electroencephalographic (EEG) signals were recorded from paired participants performing a rock–paper–scissors task initiated by a synchronized arm swing. Focusing on transitions from asynchronous to synchronous states, we are developing temporal analysis methods to characterize fluctuations in inter-brain connectivity underlying coordinated behavior. This framework enables quantitative assessment of neural coupling and may inform adaptive human–robot coordination systems.



GS7-2 Extending LabStreamingLayer for Synchronized Monitoring of Expert Bus Drivers: GPS, Camera, Motion, and Eye-Tracking Integration for Risk-Point Analysis

Shabbir Mahmood[1], Tomoki Taniguchi[1], Hodaka Inoue[1], Rena Kato[1], Kosei Shibata[1], Obada Al Aama[1], Davaanyam Jargal[1], Diunuge Buddhika Wijesinghe[1], Hakaru Tamukoh[1] and Hiroaki Wagatsuma[1]
([1]Kyushu Institute of Technology, Japan)

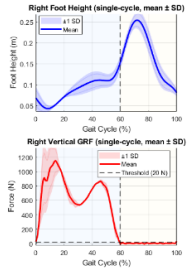
LabStreamingLayer (LSL), originally developed for real-time acquisition of biosignals such as EEG, provides a flexible framework for synchronized data streaming across devices, including gaze and behavioral motion tracking. We extended its generality to develop a system for monitoring expert bus drivers' decision-making by synchronizing GPS (vehicle location), external cameras (other vehicles), driver motion sensors (action timing), and eye-tracking data (attention). This system enables effective risk-point detection, visualization of drivers' decision processes, and mapping of detected risk points onto geographic data.



GS7-3 Dynamics of Landing and Push-Off in Running for Implications on Prosthetic Limb Design

Choisuren Purevdorj[1], Abhinav Sharma[2], Kosei Shibata[1], Tomoki Taniguchi[1], Shintaro Kasai[1], Rena Kato[1], Yiqian Ge[1] and Hiroaki Wagatsuma[1]
([1]Kyushu Institute of Technology, Japan; [2]Indian Institute of Technology Kanpur, India)

The analysis of the muscular-mechanical system during ground contact in walking and running is an inevitable in biomechanics. In particular, the generation of force vectors that absorb impact at landing and convert it into forward propulsion is essential for normal locomotion, especially during running. When the heel strikes the ground, the center of mass shifts toward the forefoot, followed by a push-off that lifts the foot from the ground. This process produces two peaks in the vertical ground reaction force: the initial impact and the subsequent push-off. We hypothesize that energy is not fully conserved during push-off, as some of the impact energy dissipates as heat, resulting in a lower second peak. We conducted experiments using a treadmill capable of switching left and right limb motions. Our study aims to quantify the dynamics of landing and push-off, providing insights that can inform the design of prosthetic limbs with automatic muscle-force adjustment.



GS7-4 Adapting Large Language Models for Contextual Classification of Hotel Guests' Comfort Feedback in Tropical Climates

Syamsul Bahri[1], Bart Dewanker[2], Solli Murtyas[3], Hadriana Iddas[4]
([12]Kitakyushu University, Japan), ([3]Institut Teknologi Bandung, Indonesia)
([4]Universitas of Muslim Indonesia, Indonesia)

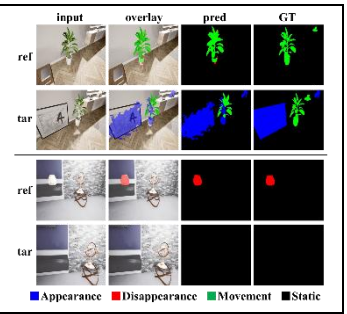
Understanding hotel guests' perceptions of comfort in tropical environments is key to enhancing indoor environmental quality (IEQ) and promoting sustainable hospitality management. This study fine-tunes large language models (LLMs) to classify guest feedback related to comfort in tropical hotels. Using 40,000 reviews from resort hotels in Bali, Indonesia (2017–2019), it identifies eight comfort dimensions: thermal environment, acoustics, indoor air quality, lighting, facilities, cleanliness and maintenance, exterior view, and interior design. The proposed Bali-IEQ-BERT model, fine-tuned from BERT-base, IndoBERT, and RoBERTa, outperforms baselines in contextual accuracy and F1-score. Sentiment and spatial analyses reveal variations in comfort perception across locations and demographics, highlighting thermal comfort, cleanliness, and acoustics as the most influential factors. These findings emphasize the value of domain-specific LLMs for sustainable hospitality in tropical climates.

Please attach one typical figure in your paper here.

GS7-5 3D Point Cloud-based Change Detection from Image Pairs Based on Cross-Attention Networks

Kazuma Morinaga, Yui Tanjo (Kyushu Institute of Technology, Japan)

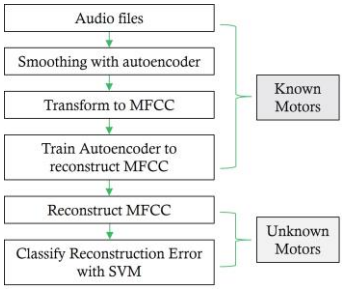
This paper proposes a method for detecting scene change patterns from a pair of images of the same location captured at different times, and classifying the change patterns into 4 types, *i.e.*, appearance, disappearance, movement and no change. To handle the difference in camera viewpoints between captured images, the proposed method reconstructs 3D point clouds from the input images and aligns them in a 3D space. Cross-attention networks are applied to the 3D point clouds to detect changed regions and sort them to the 4-types of change patterns. The proposed method is expected to support daily activities of visually impaired people. It may have further application to assistive robots, or even to enhancing safety management in care facilities and medical environments.



GS7-6 Analysis of Generalization Pertinency in Autoencoder-Based Anomaly Detection for Industrial Motor Sounds Using SVM

Jamil Md Shafayet[1], Praveen Nuwantha Gunaratne[2], Hiroki Tamura[2]
([1]Interdisciplinary Graduate School of Agriculture and Engineering, University of Miyazaki, Japan;
[2]Faculty of Engineering, University of Miyazaki, Japan)

Anomaly detection in industrial instruments is crucial for maintaining facility performance. Sound classification offers important attributes for automation, including information about machine type, operational state, and speed. Therefore, automatic detection of anomalous machines can reduce time, labor, cost, and human error. The core challenge addressed in this study is achieving generalization in classifying anomalous motors based on their sound. Autoencoders are widely used for anomaly detection; in this work, an autoencoder was trained on normal and abnormal motor sounds, transformed into Mel Frequency Cepstral Coefficients (MFCCs), to generate reconstruction errors. Another autoencoder was used beforehand to reduce noise in the raw audio data. The resulting reconstruction-error sequences were then classified using a Support Vector Machine (SVM) on MFCC data that were unseen in the previous stage. This approach enables generalized anomaly detection for previously unknown motor types. Various combinations of data folds were analyzed to evaluate the model's limitations.



GS8 Aircraft (3) online presentation

GS8-1 Human Behavior Learning for A Class of Norm-Bounded Uncertain Linear HiTL Systems via Adaptive Inverse Optimal Guaranteed Cost Control

Wen-Hua Li(Beihang University, China), Huai-Ning Wu (Beihang University, Hangzhou International Innovation Institute of Beihang University, China)

This paper presents an adaptive inverse optimal guaranteed cost control (IOGCC) approach for norm-bounded uncertain linear human-in-the-loop (HiTL) systems. The method addresses the challenge of learning human behavior modeled by an optimal guaranteed cost control (GCC). The matrix weighting the quadratic cost function is initially unknown. Our approach consists of two steps: first, an adaptive law estimates the control gain matrix from system state data in real time, with a leakage term to reduce model uncertainty effects. Then, using the learned control gain matrix, we solve a linear matrix inequality (LMI) optimization to identify the matrix that weights the human cost function. The effectiveness of the method is validated through a lane-keeping simulation.

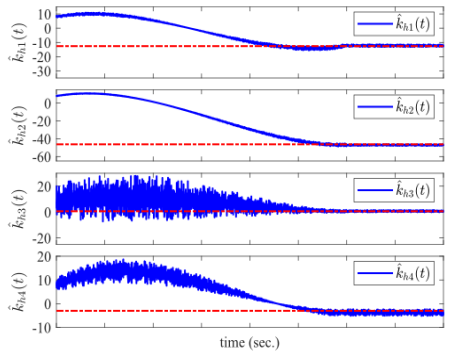
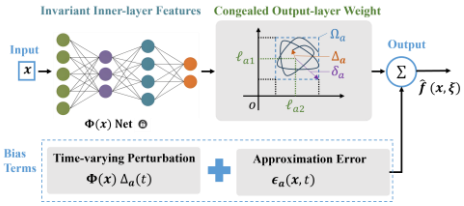


Fig. 1 Estimate of $\boldsymbol{K}_h$

GS8-2 Congealed Deep Neural Network-based System Identification for Morphing Aircraft

Hao-Chi Che (Beihang University, China), Huai-Ning Wu (Beihang University, China; Hangzhou International Innovation Institute, Beihang University, China)

This paper proposes a new deep neural network (DNN) architecture called the congealed DNN for system identification of morphing aircraft (MA). The developed DNN consists of two parts: the invariant features of the inner layers and the time-varying weights of the output layer. For the inner invariant features, a novel meta-learning with adversarial optimization framework is developed to derive a common representation function shared by different deformation conditions. For the time-varying weights, we consider them to be composed of congealed weights and time-varying perturbations. The congealed weights are estimated using standard adaptive techniques, while a sliding mode-like function is employed to attenuate time-varying disturbance terms. The experimental results indicate that the proposed method demonstrates more precise and faster adaptation capabilities to the MA system compared to other methods.



Description of the congealed deep neural network architecture.

GS8-3 Research on Active Disturbance Rejection Control for Load Coordination System of Supercritical Thermal Power Units

Li-Rong Zhang (Beihang University, China), Hai Zhang (Beihang University, China)

Enhance the flexibility and adaptability of peak shaving and frequency regulation for thermal power units is a crucial for the stable operation of new energy generation and power grids. This paper proposes an Improved Linear Active Disturbance Rejection Control (ILADRC) method for the load coordination system of thermal power units to improve stability and flexibility under multi-condition peak shaving modes. Bandwidth parameterization is employed to reduce the complexity of ILADRC parameter tuning. A feedforward compensation mechanism is introduced to overcome the impact of large delays on the boiler side on dynamic performance. Combined with an extended state observer (ESO) to estimate and compensate for internal and external total disturbances in real-time. Compared with PID control, ILADRC demonstrates certain advantages in dynamic response speed, disturbance rejection capability, and cross-working-condition adaptability, significantly enhancing the system's applicability across multiple operating conditions and robustness under varying conditions.

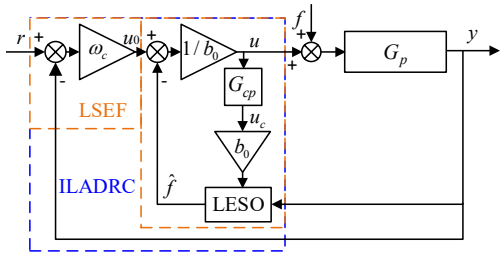


Fig. 1 Improved LADRC structure

Poster (1)
Chait Takao Ito (Hiroshima University, Japan)

POS1 EEG-Based Prediction of Concentration Rank During Zentangle Practice Using Frequency-Specific Features and Machine Learning

Ting-Chien Chuang, Muhammad Usman, Yao-Tien Chen (Ming Chi University of Technology, Taiwan)
Chun-Ling Lin*(National Taipei University of Technology, Taiwan)

Predicted and actual Concentration rank (CR) across five EEG frequency bands using RF, SVR, and KNNat four feature selection levels (100%, 70%, 50%, 25%)