

List of Dissertation Abstract (Department of Information Environment)

Name	Supervisor	Title	Abstract
Utsugi Moe	Tomii Takashi	Design of GUI Commutativity for an SQL-Extended Information Visualization Language and Evaluation of Its Effectiveness in Lifelog Analysis	In our previous studies, we proposed a system for visualizing multivariate data using the Parallel Coordinates Plot (PCP), in which the visualization state can be saved and reproduced using a SQL-like proprietary language representation. In this study, we propose (PC) ² DV V2, which reduces data processing time and supports GUI-based operations. Using the proposed system, we present a case study that visualizes seasonal and weekday dependencies in annual power consumption data, and demonstrate its effectiveness in supporting data analysis.
Ogawa Taichi	Okajima Katsunori	The Effect of Dynamic-Texture Projection via Projection-Based AR on Food Recognition	Combining AR and image processing to manipulate only the appearance of food can alter sensory perception during consumption by inducing cross-modal effects between vision and taste. This study aimed to enhance the dining experience by using projection AR for appearance manipulation and employing “dynamic textures” to emphasize the sizzle effect through projections timed to the hamburger's surroundings and the moment it is cut. The results demonstrated that this approach can increase perceived various deliciousness in actual eating evaluations.

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Korogi Keisuke	Tanabe Ryoji	Analyzing the Landscape of the Indicator-based Subset Selection Problem	The indicator-based subset selection problem (ISSP) involves finding a point subset that minimizes a quality indicator. The ISSP is found in evolutionary multi-objective optimization. An in-depth understanding of the landscape of the ISSP could be helpful in developing efficient subset selection methods and explaining their performance. However, the landscape of the ISSP is poorly understood. This paper analyzes the landscape of the ISSP by using various landscape analysis measures and exact local optima networks. This paper mainly investigates how the landscape of the ISSP is influenced by the choice of a quality indicator and the shape of the Pareto front.
Sakata Yuto	Shirakawa Shinichi	Malicious Traffic Detection Using Dataset Distances as Measures of IoT Device Heterogeneity	In recent years, cyberattacks targeting vulnerabilities in IoT devices have become a serious problem. In machine-learning models for detecting such malicious communications, detection performance is known to degrade when the data collection environment or the types of devices differ between the training data and the operational data. However, methods for constructing models that address performance degradation caused by differences in communication characteristics among IoT devices have not been sufficiently investigated. Therefore, this study proposes a weighted ensemble learning method for malicious communication detection that considers inter-device differences by computing distances between datasets and assigning weights to the outputs of individual models trained on each device's dataset.

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Yoshikawa Takushi	Tanabe Ryoji	Algorithm Selection for Computationally Expensive Black-box Optimization	In practical black-box optimization, trial-and-error algorithm selection is necessary to identify the best optimization algorithm for a given problem. To address this issue, feature-based automated algorithm selection has been studied in the evolutionary computation community. This master's thesis investigates the performance of automated algorithm selection systems in more challenging situations that assume real-world applications of black-box optimization.
Goya Kotoe	Yoshioka Katsunari	Identifying IoT Devices and Generating Signatures from WebUIs Using Large Language Models	To mitigate risks from exposed IoT devices, we propose an LLM-based approach that automatically analyzes WebUI HTML and screenshots to identify manufacturers, models, facilities, and societal criticality. Our method also generates signatures for efficient device discovery. Results show 89.9% identification accuracy for critical infrastructure and high consistency with human-crafted signatures. Furthermore, an Internet-wide scan of a Japanese ISP identified 23,438 devices across 496 models, demonstrating the framework's scalability and practicality for large-scale risk assessment.

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Pham Hoang Oanh	Okajima Katsunori	Effects of Dynamic Visual Information and Touching Methods on Tactile Texture Perception of Virtual Sheets	We proposed a new pseudo-haptic method to generate tactile sensations of thin and soft materials (fabric or paper) using only dynamic visual information, without relying on physical feedback devices. In our system, sheets were visually rendered in a virtual environment, and participants interacted with them using a virtual hand associated with their real hand. The experimental results showed that touching methods affected the perception of tactile qualities. In particular, when participants deformed the dynamic sheet presented in mid-air according to their hand movements, the pseudo-haptic sensation was significantly enhanced. Furthermore, it was shown that the visual appearance of the virtual sheet altered the perceived material qualities.
Aoto Riku	Yoshioka Katsunari	Large-Scale Discovery and Analysis of Cybercrime-Related Channels on Telegram	In this study, we proposed an automated system for collecting and classifying cybercrime-related channels on Telegram using its similar-channel recommendation feature and a large language model (LLM). From May to December 2025, the system collected 41,788 channels and approximately 740 million messages, achieving F1 scores of 0.90 for malicious channel detection and 0.94 for category classification. It also revealed relationships among categories, language distributions, and the increasing trade in stolen credentials, providing a systematic picture of cybercrime activity on Telegram.

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Ando Chihiro	Harashita Shushi	The Lang-Trotter conjecture on average for genus-2 curves with S_3 reduced automorphism group	For an elliptic curve over the rational field without complex multiplication, Lang and Trotter conjectured an asymptotic estimation of the number of primes at which the elliptic curve has a supersingular reduction. While it remains an open question, an average estimation related to the Lang-Trotter conjecture was established by Fouvry and Murty. This result is called the Lang-Trotter conjecture on average. We extend the Lang-Trotter conjecture to curves of genus 2 and obtain a similar result to the Lang-Trotter conjecture on average for curves of genus 2 with reduced automorphism group containing the symmetric group of degree 3.
Ito Kaito	Okajima Katsunori	Development of a VR Dance Learning System Using Whole-Trajectory Presentation and Superimposed Speed Information	It is difficult for beginners to accurately understand and reproduce complex dance movements. This difficulty stems from conventional presentation methods that replay target motions, requiring learners to process both temporal and spatial information simultaneously. To address this, we proposed a VR system that separates and presents target motions into trajectories and speed information. We investigated whether visualizing the entire target motion and allowing for self-paced observation of its structure is effective for reproducing complex hand movements. Our results demonstrated that the proposed method improves the spatial accuracy of movement reproduction.

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Ito Hikaru	Yoshioka Katsunari	A Study on Sandbox Hardening Using Proof-of-Concept Evasive Code	As malware threats continue to grow, sandbox systems that automatically execute large numbers of samples and inspect their behavior have become increasingly important. However, more malware now detects sandbox environments and suppresses its real behavior to evade analysis. To address this problem, we propose a method that uses a large language model (LLM) to analyze proof-of-concept evasion code and automatically generate the configuration changes and countermeasure scripts needed to enhance the sandbox. We evaluated 43 samples that evaded analysis in a default open-source CAPE sandbox and successfully analyzed 31 of them (about 72%), demonstrating strong effectiveness in improving evasion resistance.
Umeoka Taisei	Matsui Kazumi	A New Algorithm for Contact simulation Using Level Set Function	This study proposes a novel contact analysis algorithm based on level set functions to overcome numerical instability caused by geometric search procedures in conventional methods. The geometry of contacting bodies is represented using a level set function. This formulation allows the penetration depth to be computed algebraically and eliminates the need for geometric search procedures. The proposed method was verified through two-dimensional and three-dimensional Hertzian contact problems. The numerical results demonstrate that the method achieves accuracy consistent with theoretical solutions and conventional approaches, while maintaining comparable numerical stability.

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Oki Yosuke	Shirazaki Minoru	CFD analysis of the water-running mechanism of basilisk lizard	This study numerically analyzed the interaction between the hindlimbs and the water surface during basilisk lizard water-running. The hindlimbs were modeled as articulated rigid bodies, and their joint motions were reproduced. A two-dimensional single-hindlimb model was used to investigate the effects of varying the upper limits of joint muscle forces under PD control. A three-dimensional single-hindlimb model demonstrated a potential trade-off between vertical force and forward acceleration depending on forward velocity. Furthermore, a three-dimensional bipedal model, incorporating pelvic rotation and interactions between the hindlimbs, was developed to simulate continuous water-running.
Omori Kenyu	Yoshioka Katsunari	A Survey on the Actual Status and Background of Router Manufacturers' Support Measures for Secure Device Use	As cyberattacks on IoT devices rise, "support measures for secure device use" are increasingly critical. However, existing research often overlooks the manufacturer's perspective. This study investigates the design intent and implementation background of these measures for home routers. Following a preliminary survey of six manufacturers' information channels, we conducted semi-structured interviews with four major domestic manufacturers. Findings reveal that support measures are heavily influenced by internal process constraints, such as siloed development between Web UI and manual production teams. Furthermore, implementation is driven not only by a desire to inform users but also by risk transfer to limit liability, support cost concerns, and usability considerations. Future work will quantitatively evaluate how these manufacturer-driven methods impact user risk perception in order to develop practical improvements.

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Ooyagi Yuusei	Mori Tatsunori	Event Labeling for Technical Document Text	In manufacturing quality regulation maintenance, regulatory documents must be reorganized on a process basis to facilitate referencing, auditing, and revision. However, clustering methods cannot account for structural consistency or hypernym–hyponym (hierarchical) relationships, while classifier-based approaches require preparing a large set of text–label pairs in advance. To address these limitations, we proposed a method that uses an LLM to structure events as predicate–argument structures and determine correspondences by extracting common structures between two texts. As a result, the predicate–argument approach with conceptual hierarchies achieved high performance, confirming the effectiveness of the proposed method.
Ogino Kotaro	Yamada Takahiro	Building Vibration Response Measurement and Structural Health Monitoring Using a Distributed Sensing Network with Edge Devices	For the long-term safety assessment of existing buildings, structural health monitoring (SHM) requires low-cost systems capable of multi-point and continuous vibration measurement. This study investigates a distributed sensing network using edge devices and MEMS accelerometers for ambient vibration monitoring of buildings and its application to SHM. We develop a multi-node measurement system, apply operational modal analysis to the measured acceleration data, and combine it with numerical simulations to examine how changes in structural stiffness can be represented and interpreted within a distributed SHM framework, focusing on long-term monitoring of ordinary buildings.

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Okumura Hijiri	Okajima Katsunori	Evaluation of Visual Comfort and Optimization of Screen Luminance for Mobile Displays Considering Diverse Indoor and Outdoor Lighting Environments	The visual comfort of mobile displays such as smartphones varies depending on the surrounding light environment. In this study, to clarify the effects of ambient and screen illuminance, background luminance, and the state of dark adaptation, experiments were conducted under conditions simulating a variety of indoor and outdoor environments. Participants evaluated the readability of text displayed on the screen and the comfort of its brightness. Based on the results, subjective evaluation scores were formulated as a multivariate function with each factor as a variable, making it possible to derive optimal screen luminance according to the environment and the observer's adaptation state.
Ono Hayate	Shirakawa Shinichi	Simplifying Annotation in Anomaly Image Generation for Industrial Products	In the industrial field, there is a shortage of anomaly product image data, and annotation costs are high, leading to proposals for generating such data using machine learning. However, existing methods require pixel-level specification of the anomaly region. Therefore, this study proposes generating anomaly product images based solely on coarse location information. In experiments, we generated anomaly images by replacing anomaly shapes with circles and evaluated their quality as a dataset. Results confirmed that even with coarse anomaly region specification, accuracy does not significantly decrease.

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Kato Shinnosuke	Fujii Tomohiro	The silent-adjunct reading in the Japanese null object construction: A truth-value judgement study	Previous theoretical studies predict that the silent adjunct reading in Japanese null object constructions is available only when the object is omitted and a native Japanese verb is used. This study experimentally tested this prediction using a Truth-Value Judgment Task. The results showed high acceptance rates in the native Japanese verb condition with null objects, supporting the prediction of previous research. However, a result not predicted by previous studies was also obtained: a correlation between the native verb null object condition and the Sino-Japanese verb null object condition.
Kanai Yosei	Shima Keisuke	Investigation of How Fingertip Force Feedback Influences Muscle Activity during Standing	To elucidate the mechanism underlying the postural stabilization effect known as the “balloon grasping effect”, we investigated the influence of force direction by comparing the conventional method (using a balloon generating upward tension) with a method generating downward tension. Additionally, we measured electromyography (EMG) signals to examine how grasping a balloon influences postural control strategies. The experimental results demonstrated that stabilization effects were achieved regardless of the direction of the force. However, we observed a shift in strategy, wherein different muscles were recruited for postural correction depending on the direction of the applied force.

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Kamata Eisuke	Matsui Kazumi	Application of Splitting Time Integrator to Shell Elements	In previous studies, the authors proposed a splitting time integrator derived from a time integration method for constrained systems to relax the time-step restriction of explicit methods in dynamic analyses of slightly compressible elastic bodies and plates. In this study, the splitting time integrator is extended to dynamic analyses of shell structures. In the proposed method, bending and membrane deformations are integrated using an explicit scheme, while transverse shear deformation is treated implicitly. Numerical experiments are conducted to evaluate the numerical characteristics of the proposed method.
Kita Shunsuke	Mori Tatsunori	Investigating Methods for Textualizing Image Content in Multimodal Technical Documents	In this study, we constructed a figure-level dataset from published Japanese patent applications that pairs drawing images with the corresponding body text. We designed two captioning tasks that generate short captions and long descriptions for each drawing. We proposed switching prompt templates according to image type and a stepwise prompting framework called Chain-of-Selection-Extraction-Captioning (CoSEC). CoSEC guides a multimodal model to select relevant text, extract key terms and relations, and compose a coherent caption. Experiments showed that using body text improves caption quality. Restricting input text works best for short captions, while providing sufficient text is more effective for long captions.

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Kihara Momoka	Yoshioka Katsunari	A Study on OSS Vulnerability Management in Router Firmware Development Supply Chains	This study investigates how Open Source Software (OSS) vulnerabilities are addressed within the router firmware supply chain. We conducted two approaches: an analysis of firmware from 126 router devices and interviews with stakeholders. The results reveal that vulnerability remediation is performed not only by router vendors but also by chip vendors and outsourced development vendors. Furthermore, while security patching is common practice, the study highlights the current difficulty in sharing the status of these fixes among stakeholders. To address this, we proposed the adoption of SBOM formats capable of documenting vulnerability patch details to facilitate information sharing across the organization.
Kudo Yuya	Shirakawa Shinichi	Configuration Method of Scaling Variables in Structural Layer-Level Model Merging	Model merging is a technique that integrates the capabilities of multiple large language models without additional training. However, merging, which involves swapping layers, requires setting appropriate parameters to resolve distribution inconsistencies between layers, and optimizing these parameters requires enormous computational costs. In this study, we propose a method to analytically derive these parameters. As a result, we have achieved an improvement in the convergence speed of optimization compared to conventional methods.

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Kojima Misora	Matsui Kazumi	EFFECT OF MATERIAL ANISOTROPY FOR SOUND PRESSURE FIELD BY USING FINITE ELEMENT ACOUSTIC ANALYSIS	In this study, using a simplified violin model, quantified the influence of wood orthotropy on sound-pressure distribution via ANSYS-based coupled structural–acoustic frequency-response analysis. A top-plate model with idealized f-holes is constructed, a bridge load is applied to represent bowing pressure, the Young’s moduli (E_L, E_R, E_T) are systematically varied, and internal sound pressure and external radiation within resonant bands are evaluated. Appropriate analysis conditions are established by consolidating governing equations, boundary conditions, and mesh dependence, and key orthotropic components governing the frequency response are identified through comparison with isotropic materials.
Kotaki Ryo	Okajima Katsunori	Investigating Human Gloss Perception Mechanisms using Machine Learning Models	This study investigates the human visual mechanism for distinguishing gloss from white patches to understand how the human visual system avoids misidentifying the latter as glossy. We analyzed a machine learning model designed to separate gloss and white patches in images. The analysis identified specific filter groups contributing to white patch suppression and demonstrated that the model prevents misidentification by detecting white patches based on edge information. Furthermore, experimental results of subjective glossiness assessment confirmed that, consistent with the model, the human visual system discriminates between gloss and white patches based on edge intensity.

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Koyano Kaito	Okajima Katsunori	The Influence of Dynamic Visual Texture of Food on Food Perception	This study developed a system that modulates real-time visual information of actual food using AR and image processing technologies, demonstrating that dynamic visual textures such as food swaying and deformation influence the perception of texture qualities like softness and jiggly sensation. Furthermore, it was revealed that key factors for effectively eliciting this cross-modal effect include changes in the appearance of the food being consumed, synchrony with the user's own actions, and the physical plausibility of the behavior.
Sakamoto Ryota	Shima Keisuke	Evaluation of postural control under multiple static standing conditions and its relationship with physical performance	In addition to the closed-leg stance traditionally used in standing function assessment, we propose a highly accurate evaluation method by measuring the semi-tandem stance. By focusing on sway in multiple stances and their differences, we assess standing functions difficult to evaluate with closed-leg stance alone. Experimental results revealed that combining closed-leg stance and semi-tandem stance enhances the correlation between assessment results and age. Furthermore, it was found that the rate of sway increase correlates with physical ability, with gender-specific differences observed. This contributes to a detailed assessment of fall risk.

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Sato Shin	Mori Tatsunori	Jailbreak Risk Assessment for LLM Defamatory Text Output Using Mathematical Prompts	While LLM capabilities have advanced in recent years, they remain vulnerable to Jailbreak attacks, and research on Japanese defamatory content is particularly scarce. This study addresses the Jailbreak risk of LLMs toward defamatory content by creating a Japanese defamation dataset and verifying safety through mathematical tasks involving negation and inference. Experimental results showed an increased proportion of defamatory text output, primarily due to a tendency to forget processing for negation tasks. We also discussed the vulnerability of LLMs to specific types of defamatory content.
Sugiyama Hiroki	Matsui Kazumi	Evaluation of ceramic grain boundary strength using first-principles calculations and vacuum layer models	In this study, a grain boundary strength evaluation method using a model that includes grain boundaries and vacuum layers was verified based on first-principles calculations. First, aluminum was used to compare the grain boundary energy obtained from the model with that from the conventional 2GBs model, and the model conditions were investigated. Based on the obtained conditions, the grain boundary energy and theoretical shear strength of zirconia were evaluated. The results confirmed that the GB+VL model is equivalent to the conventional model and demonstrated that grain boundaries contain slip directions with lower strength than those of single-crystal slip systems.

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Sekino Yuta	Shirakawa Shinichi	Surrogate-Assisted CMA-ES for Problems with Low Effective Dimensionality	Surrogate-assisted CMA-ES is effective for black-box optimization problems but performs poorly on problems with redundant design variables. In this study, we propose a method that estimates the influence of each variable using SNR. By applying these estimates to surrogate construction, our method suppresses the effect of redundant variables. The experimental results show the effectiveness of our method on problems with redundant variables.
Takasuka Sota	Shima Kesuke	A Multimodal Stimulation System Targeting Three Sensory Systems for VR Motion Sickness Reduction	In VR using head-mounted displays, motion sickness caused by mismatches between visual and vestibular/somatosensory inputs remains a challenge. This study proposes a headmounted multimodal stimulation device capable of simultaneously delivering vestibular electrical stimulation (GVS) and vibrotactile stimulation to the cheeks and neck, synchronized with visual motion. Subject experiments revealed that GVS and vibrotactile stimulation below sensory thresholds significantly reduced motion sickness, with combined use of both stimuli further enhancing the effect. Vibrotactile stimulation also showed a tendency to improve immersion, demonstrating the effectiveness of multisensory simultaneous presentation.

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Takahata Fumiya	Nakamoto Atsuhiko	Bipartite domination in outerplanar graphs	For a graph G , a subset of vertices S is a bipartite dominating set if every vertex of G is contained in S or adjacent to a vertex of S , and if the subgraph of G induced by S is bipartite. The bipartite domination number of G is the minimum cardinality of all bipartite dominating sets of G . Yue and Xi claimed that every 2-connected outerplanar n -vertex graph has a bipartite domination number at most $\lceil n/3 \rceil$. Pointing out an error in the result, we proved the correct bound is $\lceil 3n/8 \rceil$, and the result is sharp.
Tanabe Rei	Shirakawa Shinichi	A Framework for Iterative Sandbox Evasion Code Generation Using Attacker and Defender LLMs	Evasive malware is designed to detect sandbox analysis environments and alter its behavior to resist analysis. While prior work has demonstrated the use of LLM for generating malware, defenders are also expected to adopt LLM for detection and countermeasures. This anticipates the emergence of evasion code designed to bypass such defenses. In this study, we propose a framework in which attacker and defender LLMs interact iteratively: the defender LLM proposes countermeasures to known evasion code, and the attacker LLM responds with new evasion techniques to bypass them. Through this process, we aim to enhance security by enabling the analysis of newly generated evasion techniques.

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Tanikawa Kanao	Shima Keisuke	A Foundational Study on Standing Impedance Analysis for Evaluating Sensory Reweighting in Human Postural Control	A new impedance-based method is proposed to quantitatively evaluate the internal characteristics of human postural control. Experiments were conducted using visual, vestibular, and somatosensory perturbations combined with virtual light touch contact (VLTC). Human upright posture was modeled as an inverted pendulum, and stiffness and damping parameters were estimated from center-of-pressure (COP) data. Participants were classified according to their sway responses to changes in sensory conditions. The results revealed differences in stiffness and damping modulation among groups, suggesting that postural stability depends on adaptive flexibility in response to sensory changes.
Tsukada Shuhei	Mori Tatsunori	A Method for Analyzing Customer Reviews Based on the Impact of Attribute Fulfillment and Deficiency on Overall Ratings	Online reviews of hotels posted on travel booking websites contain evaluations of various attributes, such as location, rooms, and meals. In this study, we focus on Japanese hotel reviews and estimate the impact of attribute fulfillment and deficiency on overall ratings using logistic regression. The presence of positive and negative mentions for each attribute is used as explanatory variables, and the overall rating is used as the dependent variable. Furthermore, by integrating the estimated impact with hotel-specific mention tendencies, we construct a framework that enables the evaluation structure of each attribute to be analyzed at the individual hotel level.

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Tsuchiya Yui	Shikata Junji	Anonymization and Security Enhancement in Construction of Post-Quantum Identity-Based Encryption	The Fujisaki–Okamoto (FO) transformation is a standard technique for achieving CCA security in public-key encryption and has recently been studied in the post-quantum setting. In this work, we investigate how to realize CCA security and anonymity for identity-based encryption (IBE) in post-quantum cryptography. We show that a slightly modified FO transformation can convert a CPA-secure IBE into a CCA-secure IBE in the quantum random oracle model. Moreover, if the underlying IBE satisfies the strong disjoint-simulatable (SDS) property, the transformation also achieves anonymity. To show that this result is not merely theoretical, we construct an SDS-satisfying IBE based on the GPV-IBE scheme, thereby demonstrating the practical feasibility of our approach.
Nakagawa Hayato	Okajima Katsunori	Perceptual Characteristics of Body and Image Roll and Pitch Angles During VR Roller Coaster Rides Using an HMD and MP	This study investigated the perceptual characteristics of roll and pitch rotation angles during a VR roller coaster ride using an HMD and motion platform. The results revealed perceptual asymmetry depending on the direction of rotation and the VR environment, as evidenced by the response probability regarding the presence or absence of discomfort during image amplification. In particular, roll rotation is less likely to cause discomfort, allowing for significant image amplification. These findings stem from the fact that, while body rotation perception remains constant, the perception of image rotation varies depending on rotation direction and VR environmental factors, providing useful guidelines for VR content design.

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Nagai Tomoki	Shirazaki Minoru	Numerical analysis of using a two-dimensional full-body model accounting for the interaction between the water surface and the human body and for muscle forces	Swimming is a popular sport and has been widely studied. However, few studies have numerically simulated swimming considering both the interaction between the human body and the water surface and the effect of muscle forces. In this study, a three-phase (solid–gas–liquid) flow simulation using a two-dimensional full-body model was conducted to reproduce front-crawl swimming. Muscle-generated torques were applied to the arm joints, and the equations of motion were solved to compute the swimming motion. In addition, the strength of the muscle torques and the arm motion patterns were varied, and their effects on swimming were investigated.
Nara Shogo	Matsui Kazumi	Validation for Thermal Deformation of Disk	Verification and Validation (V&V) ensures the reliability of numerical simulations. This study analyzes ceramic disk sintering and identifies tensile stress at the disk center that appears only in finite deformation analysis, suggesting it originates from geometric nonlinearity rather than thermal strain differences. By comparing finite and small deformation theories using simplified models, the force equilibrium in the cross-section is examined. Elastica theory and a 1/4 disk model are used for verification, and equilibrium equations are derived to explain the stress mechanism. Numerical experiments with rotating ring elements further evaluate stress distribution, enabling physical interpretation and validation of the analytical model.

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Nambu Jota	Shima Keisuke	An Unsupervised Incremental Learning Method for Open-Set Recognition Based on a Log-Linearized Two-Stage IGMM	We propose a novel unsupervised learning method for constructing a classifier capable of open-set recognition without supervision. The proposed method has a two-layer architecture: the first layer employs an Infinite Gaussian Mixture Model (IGMM) with a Chinese Restaurant Process to capture the global structure of the data, while the second layer uses an IGMM based on a stick-breaking process to hierarchically and in parallel subdivide each cluster, thereby modeling detailed data structures. Experimental results demonstrate that the proposed method achieves higher log-likelihoods than conventional IGMMs across various datasets, indicating improved data structure estimation capability.
Nishimoto Toshiyuki	Shirakawa Shinichi	Efficient Gradient-Based Optimization of Merge Parameters for Large Language Models	Model merging is a method for integrating the capabilities of multiple large language models without additional training. However, its performance heavily depends on hyperparameters known as merge parameters, such as scaling factors and drop rates. Conventional optimization method of these parameters using evolutionary algorithms often suffers from high computational cost. This study proposes an efficient optimization method for merge parameters via gradient-based methods. Specifically, we enable gradient-based optimization by applying continuous relaxation to non-differentiable operations. Our results demonstrate that our approach achieves performance comparable to evolutionary methods while significantly reducing computational costs.

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Ninomiya Yumika	Nakamoto Atsuhiko	Convex Quadrangulations of a Polygon	Given an n -sided polygon P on the plane, a quadrangulation of P is a geometric plane graph such that the boundary of the outer face is P and that each finite face is quadrilateral. A non-quadrangulatable even-sided polygon P can be quadrangulated by adding Steiner points. In this paper, we extend results for general quadrangulations and consider the number of Steiner Points required to obtain a quadrangulation in which all faces are convex quadrilateral. Restricting our attention to the case where the polygon has exactly one consecutive chain of reflex vertices, we obtain a tight bound with respect to the number of vertices of the polygon.
Nomiyama Akari	Noma Atsushi	Conditions for the linking of space curves consisting of 2 plane curves	In three-dimensional projective space, two curves, that means equidimensional, one-dimensional, locally Cohen-Macaulay schemes, are said to be directly linked if their union is a complete intersection. The equivalence relation generated by these direct links plays an important role in curve theory. Migliore (1986) proved that two space curves, each consisting of a line and a conic, are linked if and only if the lines and planes containing the conics pass through the same point. The purpose here is to show that two space curves, each consisting of two disjoint plane curves, are linked only if the degrees of the two plane curves are the same and all planes containing the plane curves contain the same line.

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Hasegawa Mizuho	Yoshioka Katsunari	A Study on the Detection and Effective Reporting of Fake Shopping Sites	While abuse reporting is a crucial measure for disrupting fake shopping sites at the infrastructure level, its effectiveness remains poorly understood. In this study, we empirically measured the impact of abuse reporting on the survival of collected fake shopping sites. Our results demonstrate that reporting strongly triggers site inaccessibility; whereas 43.4% of unreported sites remained accessible after 30 days, approximately 20% of the reported group was terminated within just two days. However, the findings also reveal a significant disparity in mitigation rates across different organizations, even when identical evidence is provided. This study demonstrates the effectiveness of abuse reporting in countering fake shopping sites and emphasizes the critical importance of strategic stakeholder selection.
Hamana Ririka	Mori Tatsunori	Research on Supporting Code Generation from Academic Papers Using Large Language Model	Reproducing experiments from academic papers in fields such as computer science sometimes requires code, but that code is often unpublished, making reimplementing time-consuming and labor-intensive. Compared with prior methods that use LLMs to automatically generate code from the text of academic papers, this study confirmed that adding to the prompt the representation of mathematical formulas in TeX format and the inclusion of code used in the cited references of the target paper enables generation of code that more closely matches the original implementation.

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Hayashi Koharu	Mori Tatsunori	Automated Scoring of Essay Questions in University Entrance Examination via Pairwise Comparisons with Large Language Models	In this research, we target essay questions in university entrance Japanese examination and we propose a new framework for automated scoring with actual scoring work. This is achieved by combining existing methods—automated scoring based on pairwise comparison with large language models (LLMs)—with the automatic generation of evaluation perspectives using annotations that indicate scoring basis. We use LLM to derive evaluation perspectives from the annotation of scoring basis, then perform pairwise comparisons using the LLM based on these perspectives. Using the generated pairwise comparison data, we estimated potential scores with RankNet, achieving performance surpassing both supervised models and zero-shot scoring by LLMs. This research reproduces scoring based on bonus items used in actual scoring work, demonstrating the potential for an effective automated scoring method under the constraint of a small number of scored answers.
Ryogo Hayashi	Shima Keisuke	Emotion Recognition from Biosignals in Eating and Drinking Contexts via Domain Adaptation	Quantitative affect monitoring supports driver assistance and service-quality evaluation, but questionnaires/interviews cannot continuously track subjective, time-varying emotions. Biosignal-based estimation is promising, yet deployment is limited by sensor burden, train–test condition shifts, and costly personalization. This thesis proposes an ECG-only, domain-adaptive model for eating/drinking. A base model learns general affective representations from video-viewing biosignals via autophagy learning; adaptation freezes the base and trains only an added regression head. To handle inter-subject variability, we examine group-wise heads using sex/age or ECG-feature clustering, and validate task transfer and robustness. Future work explores diverse conditions and online adaptation.

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Baba Daiki	Yoshioka Katsunari	An Analysis of Telegram's Moderation Measures Against Cybercrime Channels and the Evasion Strategies of Attackers	This study investigates how Telegram moderates cybercrime-related content and how attackers evade these measures. Analyzing approximately 50,000 cybercrime channels from 2015 to 2025, the research identifies two moderation types: channel-level and message-level. The primary reasons for moderation were copyright infringement, pornography, and term violations, with enforcement visibility varying significantly across platforms like Android and iOS. Furthermore, the study highlights attacker evasion strategies, revealing that 60% of malicious channels frequently alter their metadata to avoid tracking. These findings provide empirical insights into Telegram's moderation practices and offer a foundation for improving platform governance transparency.
Fukai Tomoki	Shirakawa Shinichi	Disease Classification and Lesion Localization for Chest X-Ray Diagnosis with Limited Training Data	Artificial Intelligence (AI) systems for medical image diagnosis currently face challenges in providing interpretable reasoning to physicians and in the high cost of creating training data. This paper proposes a novel medical image classification model that integrates three key features: visualization of attention regions, learning of annotation maps indicating lesion locations, and reduction of the amount of training data required. Evaluation experiments using a chest X-ray dataset demonstrated that the proposed method outperforms the baseline approach in terms of both classification performance and the clinical validity of the generated reasoning.

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Fukumoto Kei	Tanabe Ryoji	Initializing the Population in Evolutionary Multi-Objective Optimization by Using a Two-phase Framework with a B'ezier Simplex-based Interpolation Method	The initialization of evolutionary multi-objective optimization (EMO) using scalarization approach demonstrates good performance under various computational cost conditions. This study verified the effectiveness of a two-phase framework with a Bézier simplex based interpolation method (TPB) for EMO initialization. Comparing TPB, random generation, the scalarization function approach, and a combination of the scalarization function approach and random generation as initial population generation methods, TPB obtained good initial populations with fewer evaluations for simplex and high-dimensional problems, but did not show good results for strongly multimodal problems.
Fujise Tatsuya	Matsui Kazumi	Statistical Reconstruction of 3D Polycrystalline Structures from Surface Observation Data	In polycrystalline materials such as ceramics, macroscopic mechanical properties are strongly dependent on microstructural factors, including crystal grains, grain boundaries, and crystal orientations. Therefore, a detailed understanding of the distribution and characteristics of grain boundaries is essential for elucidating the strength properties of polycrystals. Bending tests using micro-cantilever specimens are effective for evaluating local mechanical properties. To identify the internal structure of these specimens, methods such

			as inverse estimation based on fracture surface observation and three-dimensional (3D) reconstruction via serial sectioning have been proposed. However, since these methods involve destructive testing and cause irreversible damage, they present challenges for re-verification using the same specimen or for direct comparison with numerical analyses based on the initial pre-experimental state. In contrast, previous studies have proposed non-destructive methods that apply Voronoi tessellation to geometrically estimate the 3D internal structure of polycrystals. However, a limitation of conventional methods is that the surface structure of the generated models is virtual and does not match that of the actual specimen. To address this issue, this study proposes a new modeling method using the Covariance Matrix Adaptation Evolution Strategy (CMA-ES). This method generates multiple 3D models that strictly preserve the experimentally observed top-surface grain structure while varying the internal structure. By generating variations of internal structures that remain uncertain based solely on surface observations, this study aims to quantitatively evaluate the influence of the observed surface on the overall material properties.
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Horimatsu Sougo	Shima Keisuke	Cepstrum-Based Estimation of Wrist Joint Angles using Electromyographic Signals	To improve continuous wrist joint angle estimation in myoelectric prosthetic hands, cepstral coefficients are introduced to efficiently represent frequency spectrum characteristics. While conventional EMG Power reflects overall intensity, it fails to capture minute spectral changes essential for fine control. The proposed method incorporates low-order cepstral coefficients with EMG Power using Ridge Regression. This approach efficiently detects muscle activity states difficult to distinguish with EMG Power alone, while minimizing calculation costs. Experimental results confirmed significant improvements in estimation accuracy, particularly in small flexion angle regions, contributing to the realization of smoother and more intuitive myoelectric prosthetic control.
Matsuo Takumi	Shirakawa Shinichi	Elitist Evolutionary Algorithm for Optimization on Sets of Points	This study addresses optimization problems on sets of points (SoP), where the search space consists of multiple independent subspaces, and the set of candidate solutions is given as combinations of point sets in these subspaces. There is an existing method, CMA-ES-SoP, based on a non-elitist strategy utilizing Delaunay triangulations. However, it suffers from high graph construction costs and slow convergence. To overcome these issues, we propose an elitist evolutionary algorithm, (1+1)-EA-SoP, which exploits graph adjacency relationships, and the midpoint-proximity graph as an alternative graph structure with low graph construction costs.

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Name	Supervisor	Title	Abstract
Matsuzawa Hikaru	Yoshioka Katsunari	A Study on the Generation of Evasive Proof-of-Concept Code for Sandbox Evaluation	This study aims to evaluate and improve sandbox resistance to evasion techniques by constructing a dataset of proof-of-concept (PoC) codes that implement evasion methods used by evasive malware. Evasion techniques were explored and implemented using a large language model and predefined classification schemes, resulting in 1,520 PoCs after validation. Application to a commercial sandbox showed that 578 PoCs successfully evaded analysis, demonstrating the effectiveness of the dataset for sandbox evaluation and improvement.
Matsushita Taisei	Shikata Junji	A Study on the Construction of Adaptively Secure Matchmaking Encryption under Weaker Cryptographic Assumptions	Matchmaking Encryption (ME) enables mutual access control between senders and receivers but poses significant challenges for achieving strong privacy. In particular, adaptive privacy under the mismatch condition is desirable in realistic threat models, yet prior constructions rely on very strong assumptions such as indistinguishable obfuscation. In this work, we present a simple and generic construction of adaptively secure ME in the mismatch setting based on witness encryption. Our scheme combines witness encryption with standard cryptographic tools, including commitments, non-interactive zero-knowledge proofs, functional tag systems, and lockable obfuscation, to hide both sender attributes and receiver policies. This result establishes the first ME with adaptive privacy under strictly weaker assumptions, improving practical feasibility.

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Matsumoto Yoshiya	Shirazaki Minoru	Two-dimensional numerical analysis of gas–liquid multiphase flow on Cartesian grids with a rubber-membrane model	A two-dimensional numerical method for gas–liquid multiphase flows including highly deformable and extensible rubber membranes was developed by combining the immersed boundary method on Cartesian grids with the mass–spring model. To prevent numerical penetration of fluid into the membrane interior, a correction procedure for the gas–liquid interface was introduced. In addition, when rubber membranes form a closed region, another correction procedure using a correction force per unit mass was applied to adjust the membrane shape and maintain the enclosed fluid volume. The method was applied to a water balloon yo-yo system to investigate how the ratio between the elastic force of the balloon membrane and the force due to the internal water pressure affects membrane elongation and the deformation ratio.
Misu Ryota	Shima Keisuke	A Spinal–Cortical Integrated Model of Central Pattern Generator and Muscle Synergy for Walking Control	A “Spinal-Cortical Integrated CPG-Muscle Synergy Model” is proposed to separately evaluate spinal rhythm generation and cortical adaptation in walking control. This model classifies electromyography signals into spinally-driven synergies responsible for steady control and cortically-driven synergies for adaptive control, thereby estimating the activity of the Central Pattern Generator (CPG) that regulates rhythmic movement. Experimental results suggested that spinally-driven synergies demonstrate high stability across various walking conditions. These findings are expected to contribute to analyzing the underlying factors of gait disorders and developing personalized rehabilitation strategies tailored to individual neural characteristics.

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Miyamoto Iwaki	Yoshioka Katsunari	Research on Clone Resistance of Artifact Metrics and Undisclosed Embedded Features in IoT Devices	This thesis investigates product security from two perspectives. Part I improves clone resistance in artifact metrics — authentication using physically unclonable nanopatterns. We demonstrate that low-cost white-light interferometers match high-end instruments in accuracy, and propose a Fourier spectrum-based clone detection method achieving F-scores of 97.65% (supervised) and 88.51% (unsupervised). Part II examines undisclosed access mechanisms in IoT firmware. Among 173,768 images from 202 manufacturers, 63 device models contained undocumented Telnet/SSH services, with 16 models allowing hardcoded remote login. Surveyed manufacturers lacked transparency regarding non-disclosure, highlighting accountability gaps in IoT security.
Yamaguchi Kohtaro	Harashita Shushi	On the automorphism groups of Artin-Schreier curves including van der Geer-van der Vlugt type	In this paper, we deal with the automorphism groups arising from coordinate transformations of several Artin-Schreier curves, including those of the van der Geer-van der Vlugt type. Here, an Artin-Schreier curve refers to a curve defined over a field K of positive characteristic p by an equation of the form $y^p - y = f(x) \in K(x)$. As our main results, we determined the order and group structure of the automorphism group and the reduced automorphism group of the curve, and, using the computational software Magma, we derived the detailed group structures and conditions for the reduced automorphism groups of several such curves.

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Yamada Yutaro	Shirakawa Shinichi	Weight Adaptation for Improving Parallel Performance of Adaptive Stochastic Natural Gradient	Probabilistic model-based black-box optimization methods compute the update direction of a distribution by weighting generated samples. While parallel evaluation of multiple samples is effective for time-consuming tasks, it remains unclear how to set suitable weights for larger population sizes. To address this, we propose a weight adaptation mechanism to maximize the signal of the estimated update direction. Empirical evaluations on various binary optimization tasks demonstrate the effectiveness of the proposed method.
Wakayama Kyosuke	Nakamoto Atsuhiko	Cell-chromatic numbers of drawings of a graph into the projective plane and the torus	Let F^2 be the plane or a surface, and let G be a graph. A cell-coloring of a drawing Γ of G into F^2 is the assignment of colors to the cells of Γ so that two cells sharing a common segment of an edge have distinct colors. The minimum integer k such that Γ admits a cell-k-coloring is called the cell-chromatic number of Γ, and denoted by $\chi^*(\Gamma) = k$. We define the chromatic spectrum $\tilde{\chi}_{F^2}^*(G) = \{k \in \mathbb{N} : G \text{ has a drawing } \Gamma \text{ into } F^2 \text{ with } \chi^*(\Gamma) = k\}$. In this paper, we obtain all possible sets of integers for $\tilde{\chi}_{F^2}^*(G)$ in the case when F^2 is the projective plane or the torus.

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Watanabe Naoki	Nakamoto Atsuhiko	Generating bipartite (2,0)-tight graphs	A graph G with n vertices is $(2,k)$ -tight if it has $2n-k$ edges and for any subgraph with m vertices has at most $2m-k$ edges. In particular, the $(2,3)$ -tight graphs play an important role in graph rigidity theory. The bipartite $(2,2)$ -tight graphs include all bipartite quadrangulations on the projective plane, and a generating theorem of them had been established. In this paper, we prove a generating theorem for the bipartite $(2,0)$ -tight graphs and discuss the differences with the corresponding generating theorem for bipartite quadrangulations on the torus/Klein bottle.
Lim Younghun	Mori Tatsunori	Study on Automatic Knowledge Graph Construction Methods for Structuring Textual Information	Knowledge graphs are a key representation for structuring text in large document collections. Although LLM-based generative KGC has advanced, most prior work assumes a fixed schema, leaving schema design largely manual. This thesis treats the schema as an optimization target and proposes an evaluation-driven method that iteratively improves schemas based on performance feedback. Starting from a shared common-structure schema, it generates candidates by mutating textual descriptions and entity–relation type configurations. Experiments on WebNLG show that automatically generated initial schemas can degrade performance, while optimized schemas consistently improve F1. These results highlight schema optimization as evaluation-driven search in the schema design space.

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XIA PING	Fujii Tomohiro	Improving Stock Price Prediction Accuracy Using a Multi-Agent LLM	This study focuses on the lack of interpretability in stock price prediction using conventional deep learning models. An existing multi-agent large language model (LLM) framework is employed, incorporating a three-layer prompt structure with clearly defined role assignments to facilitate specialized reasoning by each agent. In addition, a confidence-based signal filtering mechanism is introduced. Experimental results demonstrate that the proposed approach is effective in improving both prediction accuracy and trading stability.
Li Xinnan	Okajima Katsunori	The Effect of the Hand's Visual Texture on Haptic Perception	This study investigates how the visual material of a virtual hand affects tactile perception in VR and proposes a method for haptic modulation based on body-image manipulation. Experimental results revealed that for hardness and roughness, a "contrast effect" occurs, where perceptions are shifted in the opposite direction of the expected properties derived from the hand's appearance. Conversely, weight perception was dominated by an "assimilation effect," where heavier-looking hands increased the perceived weight. These characteristics are thought to stem from cognitive processing that uses the body as a frame of reference. Furthermore, a synergistic effect with conventional methods for modulating object material perception was demonstrated.