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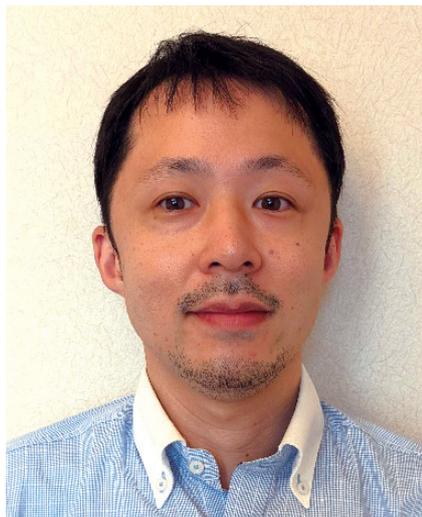
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INDEX

Kazuki YANAGISAWA	2
Associate Professor, Department of Mechanical Engineering	
Keisuke KAZAMA	4
Senior Assistant Professor, Department of Mechanical Engineering	
Atsushi ISHIZAWA	6
Professor, Department of Electrical and Electronic Engineering	
Kousaku SHIMIZU	8
Professor, Department of Electrical and Electronic Engineering	
Naoyuki SUGIHASHI	10
Professor, Department of Civil Engineering	
Hiroyuki NOGUCHI	12
Senior Assistant Professor, Department of Civil Engineering	
Mizuki FUKUMURA	14
Assistant Professor, Department of Architecture and Architectural Engineering	
Rikako FURUTA	16
Assistant Professor, Department of Architecture and Architectural Engineering	
Satoshi TANAKA	18
Professor, Department of Applied Molecular Chemistry	
Taka-aki HOSHINA	20
Associate Professor, Department of Applied Molecular Chemistry	
Yuto OMAE	22
Senior Assistant Professor, Department of Industrial Engineering and Management	
Shiho HORIO	24
Assistant Professor, Department of Industrial Engineering and Management	
Yoshihisa FUJITA	26
Assistant Professor, Department of Mathematical Information Engineering	
Kosuke ZAITSU	28
Assistant Professor, Department of Mathematical Information Engineering	
Keiko NAGAMURA	30
Associate Professor, Department of Sustainable Engineering	
Iku SAITO	32
Assistant Professor, Department of Sustainable Engineering	
Mika KATO	34
Professor, Department of Conceptual Design	
Hodaka YAMAGUCHI	36
Assistant Professor, Department of Conceptual Design	
Yuta MINAGAWA	38
Senior Assistant Professor, Department of Liberal Arts and Basic Sciences	
Hitoshi SHIBAYAMA	40
Senior Assistant Professor, Department of Liberal Arts and Basic Sciences	

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Research Achievements

- 1) Development of “Ovot,” a Partner Robot, Provides Feedback to the Learner on Stress Conditions, *IEEJ Transactions on Electronics, Information and Systems*, Vol. 145, No. 7, pp. 631–638, 2025.
- 2) Development of Reinforcement Learning Robot Teaching Material That Integrates Virtual and Real Environments to Experience Reality Gap, *Transactions of the Society of Instrument and Control Engineers*, Vol. 60, No. 10, pp. 555–562, 2024.
- 3) Verification of the effect of using multiple therapy robots on stress reduction, *Transactions of the Human Interface Society*, Vol. 26, No. 3, pp. 329–340, 2024.



“Ovot” Partner Robot



Appearance of “Mulpy” Therapy Robot

Development of “Ovot,” a Partner Robot, Provides the Learner with Feedback on Stress Conditions

Harutaka YOKOSUKA, Hayato ASHIKAWA and Kazuki YANAGISAWA

Humans are known to exhibit a higher performance under moderate stress, as described by the Yerkes–Dodson law. However, few studies have investigated learning support robots that take into account the learner’s stress state. In this study, we focused on biofeedback, a technique in which physiological information such as heart rate and brain activity is measured, converted into visual or auditory information, and presented to the learners, enabling them to voluntarily control their own state. We developed and evaluated a learning support robot named “Ovot,” which analyzes the learner’s stress state based on heart rate information and provides feedback accordingly. Ovot measures stress levels using a wearable device and delivers stress feedback by changing its LED colors and adjusting the position of its head. In the evaluation experiment, participants engaged in one hour of learning under two conditions: with and without feedback from Ovot. The learners’ performance was defined as an executive function, which was assessed using a Stroop task administered before and after the learning session. Reaction times in the Stroop task were analyzed, revealing that the reaction times were significantly shorter under the condition with feedback compared to the condition without feedback. These results indicate that the use of Ovot helps learners maintain appropriate stress levels and contributes to performance improvement. This study was also presented as part of an outreach activity at the special “Measurement” exhibition held at the Chiba Museum of Science and Industry in 2023, commemorating the 150th anniversary of Chiba Prefecture.

Keywords: Biofeedback, partner robot, biometric measurement, learning support

学習者にストレス状態をフィードバックする パートナーロボット Ovot の開発

人間は、適度なストレス下において高いパフォーマンスを発揮することが知られている（ヤーキーズ・ドットソンの法則）。しかし、学習者のストレス状態を考慮した学習支援ロボットに関する研究はほとんど行われていない。本研究では、心拍情報や脳活動などの生体情報を計測し、それらを視覚や聴覚情報などに変換して提示することで、使用者が自身の状態を随意制御できるようにする技法であるバイオフィードバックに注目した。心拍情報から学習者のストレス状態を分析し、その結果をフィードバックする学習支援パートナーロボット「Ovot」を開発し、その効果を評価した。開発した「Ovot」は、ウェアラブルデバイスを用いてストレス状態を計測し、LEDの色変化やロボット頭部の位置変化によってストレスフィードバックを行う。

評価実験では、Ovotからのフィードバックがある条件とない条件で、参加者に1時間の学習を行わせた。学習者のパフォーマンスを「実行機能」と定義し、学習前後にストロープ課題を実施して反応時間を測定した。その結果、フィードバックあり条件では、なし条件と比較して反応時間が有意に短縮することを確認した。これにより、Ovotの活用は学習者が適切なストレスレベルを維持し、パフォーマンスの向上に寄与することが示された。

なお、本研究はアウトリーチ活動の一環として、千葉県誕生150周年記念事業「令和5年度千葉県立現代産業科学館企画展『はかる』」に出展した。

キーワード：バイオフィードバック，パートナーロボット，生体計測，学習支援

Journal (掲載誌)

IEEJ Transactions on Electronics, Information and Systems, Vol.145, No.7, pp.631-638, 2025 (in Japanese).

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Research Achievements

- 1) Reconstruction of the Driving Environment at the Time Recorded in the Dashcam Video using Image Registration with Semantic Information, *International Journal of Automotive Engineering*, Vol. 16. No. 2, pp. 33–39, Apr. 2025.
- 2) Numerical analysis on tractor axle suspension for steering instability induced by bump disturbances, *Bio-systems Engineering*, Vol. 242, pp. 100–106, Jun. 2024.
- 3) Performance Evaluation of Image Registration for Map Images, *Journal of Robotics and Mechatronics*, Vol. 35, No. 1, pp. 153–159, Feb. 2023.



Reconstruction of the Driving Environment at the Time Recorded in the Dashcam Video Using Image Registration with Semantic Information

Kazuma KASHIWABARA, Keisuke KAZAMA and Yoshitaka MARUMO

Safety assurance tests reflecting actual accidents or near-misses are necessary to ensure the safety of automated driving systems. In such tests in a simulated environment, vehicle trajectories and road environments reproduced from near-miss data recorded on a drive recorder are used. In this study, a method is proposed to reconstruct the trajectory of the ego vehicle and the road environment at the time the vehicle traveled from the dashcam video recorded on the drive recorder. The movement of the ego vehicle is obtained using image registration utilizing weights calculated from the semantic information obtained by semantic segmentation. Based on the ego vehicle's motion between frames calculated by image registration, the trajectory of the ego vehicle and the map of the driving environment are reconstructed. The validation of the proposed method on several dashcam videos suggests that it is possible to reconstruct the driving environment by image registration using semantic information.

Keywords: Localization, image registration, automated driving, active safety, dashcam video

セマンティック情報を利用した画像位置合わせによる ダッシュカム映像に記録された当時の走行環境の再構築

自動運転車両を一般に普及させるためには、自動運転システムの安全性を保障する必要がある。ドイツの PEGASUS RESEARCH PROJECT や日本の Safety Assurance KUDOS for Reliable Autonomous vehicles (SAKURA) RESEARCH PROJECT, Japan Automobile Manufacturers Association では、シミュレーションを活用して安全性を評価するシナリオベースの手法が提案された。自動運転の安全性評価に用いる検証シナリオは、合理的に事故発生が予見される状況が求められる。そのため、シミュレーション環境での検証シナリオを構築する際には、実際の交通環境で発生した事故やヒヤリハットの状況に基づいてシナリオを作成することが求められる。しかし、記録されたデータから車両軌跡を推定するだけでは不十分である。検証シナリオ作成に必要なパラメータを確定するためには、車両の詳細な走行挙動を推定する必要がある。これは、単に走行車線を特定するだけでなく、自車両がその車線内でどのような軌跡を描いたのか、例えば路面標示に対する相対的な位置を推定することが求められる。しかしながら、事故・ヒヤリハット場面における路面上の詳細な軌跡を復元する研究は、十分に行われていない。また、シナリオ作成の根拠となる、事故・ヒヤリハットが記録されたデータは数が少なく、貴重である。そこで、ドライブレコーダやダッシュカムに記録されたデータ活用が期待されている。一般に普及しているドライブレコーダに記録されるデータは、ダッシュカム映像、Global Navigation Satellite System(GNSS)の測位データ、加速度データである。GNSSの測位データと加速度データを用いて自車両の軌跡推定を行うことができるが、走行領域内の再現をすることができない。本研究では、ドライブレコーダに記録されるダッシュカム映像から自車両の位置と走行した当時の道路環境を再構成する手法の提案を行う。自車両の動きは、セグメンテーションによって得られた意味情報から計算される重みを活用した画像レジストレーションを用いて求める。画像レジストレーションによって算出されたフレーム間の自車両の動きをもとに、自車両の位置と走行環境地図を再構成した。複数のダッシュカム映像に対して提案手法を検証したことで、セマンティック情報を利用した画像位置合わせによる走行環境の再構成が可能であることが示唆された。

キーワード：自己位置推定、ヒヤリハットデータ、画像位置合わせ、自動運転、アクティブセーフティ

Journal (掲載誌)

International Journal of Automotive Engineering, Vol.16. No.2, pp.33-39, Apr 2025

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Research Achievements

- 1) Single-comb Vernier method for precise optical-frequency measurement, *Optics Express*, Vol. 33, pp. 16684–16695, 2025. (<https://doi.org/10.1364/OE.550408>)
- 2) Architecture for coherent dual-comb spectroscopy and low-noise photonic microwave generation using mechanically actuated soliton microcombs, *Optics Letters*, Vol. 50, pp. 1417–1420, 2025. (<https://doi.org/10.1364/OL.554432>)
- 3) Observation of Acoustically Induced Dressed States of Rare-Earth Ions, *Physical Review Letters*, Vol. 132, 036904, 2024. (<https://doi.org/10.1103/PhysRevLett.132.036904>)
- 4) Sub–30–fs fibre-coupled electro-optic modulation comb at 1.5 μm with a 25 GHz repetition rate, *Electronics Letters*, Vol. 59, Issue 11, e12830, pp. 1–3, 2023. (<https://doi.org/10.1049/ell2.12830>)
- 5) Optical-referenceless optical frequency counter with twelve-digit absolute accuracy, *Scientific Reports*, Vol. 13, 8750, 2023. (<https://doi.org/10.1038/s41598-023-35674-8>)

Optical-referenceless optical frequency counter with twelve-digit absolute accuracy

Atsushi Ishizawa, Tadashi Nishikawa, Kenichi Hitachi, Tomoya Akatsuka and Katsuya Oguri

An optical frequency comb is a special light source that produces a “comb-like” spectrum consisting of evenly spaced frequency lines. It is a key technology for ultra-precise optical frequency measurement and optical-to-microwave frequency conversion, with applications in metrology, spectroscopy, satellite positioning, and optical communications. Conventional mode-locked fiber or Ti:sapphire laser-based combs have narrow frequency spacing of several tens to hundreds of megahertz, making it difficult to isolate and control individual comb modes, which limits their use in high-speed optical communications. As an alternative, electro-optic (EO) combs—generated by modulating a continuous-wave laser with an electro-optic modulator—offer wide frequency spacing of several tens of gigahertz and can be electrically tuned. However, EO combs are susceptible to phase noise originating from the driving microwave signal, resulting in degraded frequency stability. Moreover, conventional stabilization schemes require two independent lasers, and the frequency drift between them limits the achievable stability. In this study, we developed a new stabilization technique for an EO comb driven by a single laser source, achieving simultaneous stabilization of both the optical and microwave frequencies. A cascaded configuration of seven phase modulators was employed to broaden the optical spectrum, and a short, highly nonlinear fiber was used to generate a wideband EO comb with a high signal-to-noise ratio. Furthermore, by introducing a dual-pitch periodically poled lithium niobate waveguide and implementing a $2f$ – $3f$ self-referencing interferometer, we achieved precise detection of the carrier–envelope offset (CEO) frequency within a reduced optical bandwidth. Feedback of the detected CEO signal to the microwave source enabled full frequency stabilization of the EO comb. Experimental results showed that the phase noise of the 25 GHz microwave signal was reduced to below the measurement limit of the phase noise analyzer, reaching stability comparable to that of a commercial hydrogen maser. In addition, the linewidth of the 811th comb line, located at a wavelength of 1397 nm, was measured to be 300 Hz—more than three orders of magnitude narrower than the linewidth typically required for digital coherent communication systems. These results demonstrate that EO combs can serve as highly stable and spectrally pure optical sources suitable for next-generation optical communication systems. This achievement is the first demonstration of frequency stabilization of a widely spaced EO comb driven by a single laser source. It opens the way for practical applications in high-capacity optical communication, precision time synchronization in GPS-denied environments, and low-noise microwave signal distribution for advanced photonic and timing systems.

Keywords: Optical frequency comb, electro-optic modulation, frequency stabilization, optical communication, microwave generation

外部光リファレンスを用いない 12 桁精度の光周波数カウンタ

本研究では、単一のレーザー光を用いた新しい EO コム安定化技術を開発し、光とマイクロ波の両方を高精度に安定化することに成功した。まず、7 台の位相変調器を直列接続した多段変調方式を採用し、短尺の高非線形性ファイバーを組み合わせることで、広帯域かつ信号対雑音比 (SN 比) の高い EO コムを生成した。さらに、デュアルピッチ PPLN 導波路を用いた $2f$ – $3f$ 自己参照干渉法により、従来より狭い帯域でキャリアエンベロープオフセット周波数を検出し、これをマイクロ波源へフィードバックすることで EO コムの周波数安定化を実現した。

実験の結果、25GHz のマイクロ波信号の位相ノイズは測定器の限界以下に低減し、市販の高精度水素レーザーと同等の安定度を示した。また、波長 1397nm における種光源から 811 本目のコムモードの線幅は 300 Hz と極めて狭く、デジタルコヒーレント通信で要求されるレーザー線幅よりも 3 桁以上小さいことを確認した。これにより、EO コムが光通信用の高品質光源として十分な性能を持つことを実証した。本成果は、広モード間隔 EO コムの単一光源による安定化を初めて実現したものであり、高速・大容量通信、精密時刻同期、およびマイクロ波信号配信など、次世代の光・電波融合技術への応用が期待される。

キーワード：光周波数コム、電気光学変調、周波数安定化、光通信、マイクロ波生成

Journal (掲載誌)

Scientific Reports, Vol. 13, 8750, 2023. (<https://doi.org/10.1038/s41598-023-35674-8>)

Kousaku SHIMIZU

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Research Achievements

- 1) Characteristics of Sputtered p-Type MoS₂ Thin Films and Their TFT Application, Journal of the Society of Materials Science, Japan, Vol. 73, No. 9, pp. 735–742, Sep. 2024.
- 2) High mobility top-gate thin film transistors fabricated with poly-Si_{1-x}Ge_x thin films on glass substrate, Journal of Non-Crystalline Solids, Vol. 338–340, pp. 740–743, Jun. 2004.
- 3) Ni-seeding effects on the properties of polycrystalline silicon–germanium grown at low temperature, Applied Physics Letters. Vol. 82, pp. 1745–1747, Mar. 2003.
- 4) Reversible Photo-Induced Structural Change in Hydrogenated Amorphous Silicon, Japanese Journal of Applied Physics, Vol. 36, Number 1R, pp. 29–32, Jan. 1997.

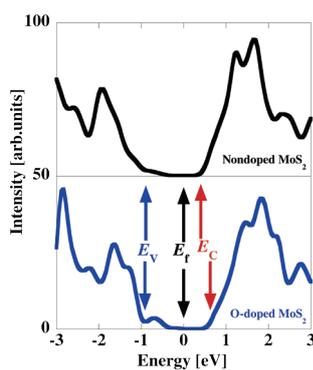


Fig. 1 DOS of MoS₂ calculated by first principles. We found that substituting oxygen for sulfur created an acceptor level, resulting in a p-type. This level can be removed by hydrogenation, changing the material to a n-type.

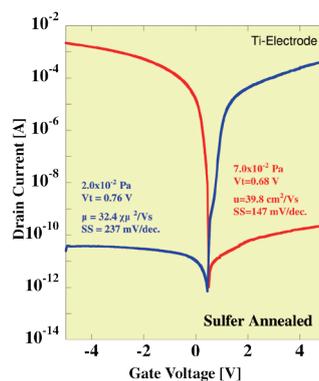


Fig. 2 The fabricated p-type transistor was converted to the n-type by hydrogenation using the hot-wire method.

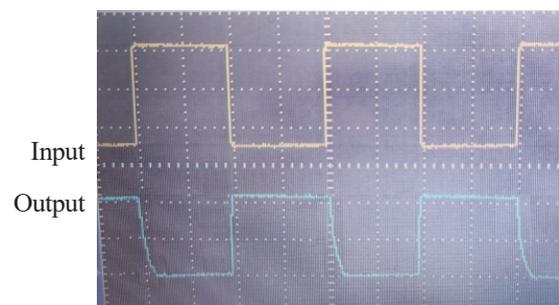


Fig. 3 Inverter output waveform. CMOS was fabricated monolithically using pn-controlled thin film transistors. The MoS₂ inverter has been confirmed to operate at 1 kHz.

Characteristics of Sputtered p-Type MoS₂ Thin Films and Their TFT Application

Kachou LI, Kousaku SHIMIZU

Two-dimensional transition-metal dichalcogenides have recently emerged as a promising material system. In particular, molybdenum (IV) sulfide (MoS₂) films have been widely investigated as one of the most promising devices for next-generation electronic transistor applications. In this study, an MoS₂ film consisting of small crystalline particles and containing a small amount of oxygen atoms substituted for sulfur atoms is deposited by radiofrequency sputtering. The film's optical bandgap is ~1.25 eV, and it exhibits p-type conduction properties. According to first-principles calculations, the oxygen doping produces a new state immediately above the valence band edge, which might explain the p-type conductivity of the as-sputtered MoS₂ film. We attempted to fabricate a p-channel thin-film transistor (TFT) with high performance. Simulation and Kelvin probe analysis of the TFT indicated that Cu is the most suitable material to make ohmic contact between the electrode and MoS₂. Cr-Cu electrodes were used. The mobility of the TFT was found to be ~31.47 cm²/(V·s) initially. After the TFT was annealed at 200°C for 1 h in air, its mobility increased to 52.42 cm²/(V·s). Analyses by Raman spectroscopy and X-ray photoelectron spectroscopy indicated that the sputtered film contained numerous sulfur defects. To compensate for the defects, we carried out oxidization by hot-wire. As a result, the mobility increased to 62.73 cm²/(V·s). Moreover, to reduce the number of metal-MoS₂ interfaces at sulfur defects, a sulfide treatment was conducted at 200°C for 1 h. An ON/OFF ratio of 2.85×10⁶ and mobility of 54.92 cm²/(V·s) were achieved after the sulfurization.

Keywords : Transition metal chalcogenide, Two dimensional materials, Field effect transistor, P-channel, FET, MoS₂

スパッタ法で作製した p型硫化モリブデン薄膜の特性と薄膜トランジスタへの応用

二次元遷移金属ジカルコゲナイドは、近年、高移動度をもつ有望な材料系として注目を集めている。特に、硫化モリブデン (IV) 膜は、次世代電子トランジスタ応用のための最も有望なデバイスの一つとして広く研究されている。本研究では、硫黄原子を少量の酸素原子で置換した微結晶粒子からなる硫化モリブデン膜を高周波スパッタリング法で堆積した。この膜の光学バンドギャップは約 1.25eV であり、我々の場合 p 型伝導特性を示す。第一原理計算によると、酸素がない場合は、n 型に、また酸素ドーピングを行うと価電子帯端直上に新しいアクセプタ状態が生成される。これがスパッタリング後の硫化モリブデン膜の p 型伝導性を説明できることを明らかにした。本研究では、高性能 p チャネル薄膜トランジスタの作製を試みた。TFT シミュレーションとケルビンプローブ解析により、電極と硫化モリブデン間のオーミック接触を形成するのに最適な材料は Cu であることを明らかにした。TFT の移動度は、最初は約 31.47cm²/(V·s) であった。TFT を空気中で 200°C で 1 時間アニールした後、移動度は 52.42cm²/(V·s) に増加した。ラマン分光法と X 線光電子分光法による分析の結果、スパッタ膜には多数の硫黄欠陥が含まれていることが示された。これらの欠陥を補償するために、ホットワイヤ酸化を行い、酸素を硫黄位置にドーピングした。その結果、移動度は 62.73cm²/(V·s) に増加した。さらに、硫黄欠陥における金属-硫化モリブデン界面の数を減らすために、200°C で 1 時間硫化物処理を行った。硫化後、オン/オフ比 2.85 × 10⁶、移動度 54.92cm²/(V·s) が達成された。硫化アニールは特に界面欠陥に効果的に作用していることを明らかにした。

キーワード：遷移金属カルコゲナイド、2次元材料、電界効果型薄膜トランジスタ、pチャネルトランジスタ、硫化モリブデン

Journal (掲載誌)

Journal of the Society of Materials Science, Japan, Vol.73, No. 9, pp.735-742, Sep. 2024.

Naoyuki SUGIHASHI

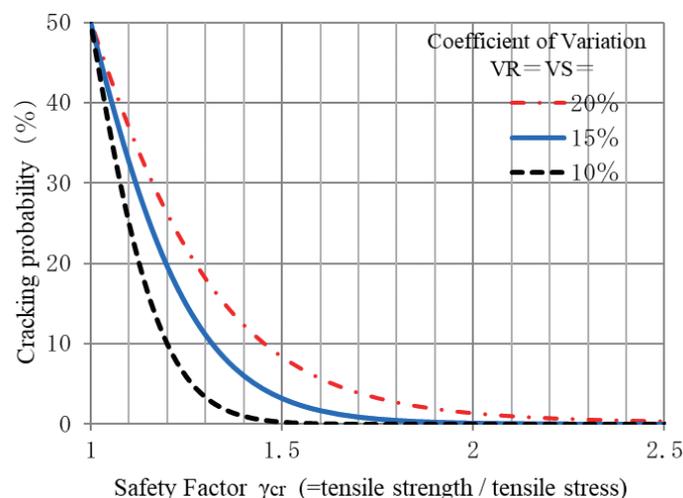
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Research Achievements

- 1) A Study on Issues with Thermal Crack Verification Method and Improving It Based on Probability Theory, Japanese Journal of JSCE, Vol. 81, No. 1, 2025.
- 2) Hydration Heat Temperature Characteristics and Long-Term Strength of Mortar with Different Replacement Ratios of Volcanic Glass Powders with Varying Specific Surface Areas, Proceedings of the Japan Concrete Institute, Vol. 47, No. 1, pp. 1446–1451, 2025.
- 3) A Fundamental Study on Strength Development of Mortar with Different Replacement Ratios Using Three Types of Volcanic Glass Powders with Varying Specific Surface Areas, Proceedings of the Japan Concrete Institute, Vol. 46, No. 1, pp. 205–210, 2024.
- 4) Influence of Fly Ash on Strength Development of Concrete and Its Temperature Dependence, XV International Conference on Durability of Building Materials and Components (DBMC 2020), Barcelona, Spain, 20–23 Oct. 2020.
- 5) A Proposal for Fundamental Improvement of the Temperature Crack Verification Method in Mass Concrete through Review of Revisions and Analysis of Contributing Factors, Proceedings of the Japan Concrete Institute, Vol. 38, No. 1, pp. 1485–1490, 2016.



Relationship between Safety Factor and Cracking Probability for Different Coefficients of Variation

A Study on Issues with Thermal Crack Verification Method and Improving It Based on Probability Theory

Naoyuki SUGIHASHI and Toshiharu KISHI

In the field of civil engineering, the thermal cracking check of concrete structures has generally been carried out using a regression curve that represents the relationship between the crack index and the probability of cracking observed in actual structures, as stipulated in the Standard Specifications for Concrete Structures. In principle, the relationship between the crack index and the probability of cracking can be theoretically expressed as a probabilistic function. Cracking occurs when the tensile stress in concrete exceeds its tensile strength, and the crack index is defined as the ratio of tensile strength to tensile stress. When the index equals 1, the probability of cracking is 50%, and it is intuitively clear that when the index is less than 1, the probability exceeds 50%. On the other hand, if both the tensile stress and tensile strength are assumed to follow normal distributions, it is considered difficult to express their ratio (the crack index) using a general probability distribution function. However, the difference between the tensile strength and tensile stress can be represented as a normal distribution parameterized by the mean values and coefficients of variation of each. By utilizing this property, it has been demonstrated that the relationship between the crack index and the probability of cracking can be theoretically derived. As a result, it was clarified that in addition to the conventional framework that controls only the mean values of tensile strength and stress, the coefficient of variation can now be introduced as a new control parameter. In other words, the construction quality can be evaluated in terms of the coefficient of variation, making it possible to regard high-quality construction management as a new countermeasure framework. The proposed formula for calculating the probability of cracking, together with the checking and countermeasure methods presented in this study, have been incorporated in the Standard Specifications for Concrete Structures (Design Code) published by the Japan Society of Civil Engineers (JSCE).

Keywords: Thermal cracks, cracking probability, crack verification, mass concrete, probability theory

温度ひび割れ照査方法の課題と確率論に基づくその改善方法に関する研究

土木分野におけるコンクリート構造物の温度ひび割れ照査は、一般的に「コンクリート標準示方書」に示されるひび割れ指数とひび割れ発生確率の実構造物における関係を曲線回帰した図を用いて実施されてきた。本来、ひび割れ指数と発生確率の関係は確率論的に関数化して理論的に扱うことが可能である。ひび割れはコンクリートに生じる引張応力が引張強度を超えたときに発生し、ひび割れ指数は「引張強度÷引張応力」と定義される。指数が1のとき発生確率は50%となり、それ以下では確率が50%を超えることは直感的にも明らかである。一方で、引張応力と引張強度をそれぞれ正規分布と仮定すると、その比であるひび割れ指数を一般的な分布関数で表すことは困難であると考えられてきた。しかし、両者の差（強度－応力）は強度と応力それぞれの平均値と変動係数をパラメータとした正規分布で表現できる。この性質を利用することで、ひび割れ指数と発生確率の関係を理論的に導出できることを示した。

これにより、従来は引張強度と応力の平均値のみで制御していた体系に、新たに変動係数を制御パラメータとして導入できることが明らかとなった。すなわち、施工や材料の管理の精度を変動係数として評価し、高品質な施工管理状態を新たな対策体系として捉えることが可能となった。

本研究でまとめたひび割れ発生確率算定式および照査・対策手法は、土木学会編『コンクリート標準示方書（設計編）』に反映されている。

キーワード：温度ひび割れ， ひび割れ発生確率， 温度ひび割れ指数， 変動係数， 正規分布

Journal (掲載誌)

Japanese Journal of JSCE, Vol.81, No.1, pp.1-10, 2025.

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Research Achievements

- 1) Proposal of Punching Shear Dynamic Model and Evaluation of Punching Shear Load Carrying Capacity of RC Slab Bridges with Bridge Spans of Parallel to the Direction, Proceedings of the Japan Concrete Institute, Vol. 47(2), pp. 133–138, Jul. 2025.
- 2) Evaluation of fatigue durability and effect of adhesive by running wheel fatigue test of precast replacement RC slabs with filling part at width direction, Journal of Structural Engineering, A, Vol. 70, pp. 784–796, Mar. 2024.
- 3) Study on Bonding Interface Technology in SFRC Pavement on Orthotropic Steel Deck Using Dismantlable Material, Proceedings of the Concrete Structure Scenarios, JSMS, Vol. 23, pp. 449–454, Oct. 2023
- 4) Load-carrying capacity of RC beam with an expansion joint and evaluation of fatigue durability by fixed point fatigue test using relational expression of modified Goodman's, Journal of Structural Engineering, A, Vol. 69, pp. 871–883, Apr. 2023.
- 5) Study on Bond Characteristic of Interface in SFRC Pavement on Orthotropic Steel Deck with Environmental Durability on Deck-Plate Surface after Anti-Corrosion Treatment, Proceedings of the Concrete Structure Scenarios, JSMS, Vol. 22, pp. 517–522, Oct. 2022.

INFLUENCE OF UFC PANEL WITH DIFFERENT SYNTHETIC SURFACE SHAPE IN UFC·RC COMPOSITE COLUMN ON AXIAL COMPRESSIVE LOAD-CARRYING CAPACITY AND FAILURE MODES OF COLUMN MEMBERS

Hiroyuki NOGUCHI, Kazuhiko MINAKUCHI, Tadashi ABE and Toshiaki SAWANO

From the perspective of maintenance and management, it is important to rationalize construction processes to achieve cost efficiency. In addition, enhancement and restoration of the load-carrying capacity and fatigue resistance of concrete structures deteriorated by fatigue and environmental degradation are essential issues to be addressed. In response to these demands, a formwork embedded within the structural member utilizing ultrahigh-strength fiber-reinforced concrete (UFC) panels has been developed as a method for achieving both rationalized construction and functional restoration of concrete structures. Consequently, the geometry of the composite interface between the UFC panel and the concrete main body is a crucial factor. In this study, axial compression loading tests were conducted with different spacing of the tie bars and the synthetic surface shape of the UFC panel using UFC·RC composite column members by focusing on the synthetic surface shape of the UFC panel used as a permanent formwork for the structural members. Axial compression loading experiments of a composite structure with different spacing of the tie bars and the synthetic surface shape of the UFC panel were verified by the effects on the axial compressive properties and failure modes. As a result, the axial compressive load capacity and failure modes of the RC column specimens and UFC·RC composite column specimens differed due to the difference in the spacing of the tie bars. In addition, the shear resistance of the synthetic surface and the adhesion with the core concrete were improved by increasing the concrete area ratio in the synthetic surface shape of the UFC panel. Therefore, it became clear that the composite structure resists axial compressive forces in an integrated manner due to the improved shear resistance and adhesion.

Keywords: Composite column, UFC panel, synthetic surface shape, axial compressive load-carrying capacity, failure mode

UFC・RC 合成柱における合成面形状の異なる UFC パネルが柱部材の軸圧縮性状および破壊モードに及ぼす影響

維持管理の観点において、コスト削減を図るための施工の合理化が求められることに加え、疲労や環境劣化による損傷を受けたコンクリート構造物の耐荷力性能および耐疲労性の向上および回復が求められている。これらに対して、施工の合理化ならびにコンクリート構造物の機能回復が図られる工法の1つとして超高強度繊維補強コンクリート (UFC) パネルを用いた構造部材埋設型枠が開発され、UFC パネルとコンクリート躯体との合成面の形状が重要となる。

本研究は、構造部材埋設型枠として活用される UFC パネルの合成面形状に着目し、帯鉄筋間隔および UFC パネルの合成面形状が異なる UFC・RC 合成柱部材を用いて軸圧縮載荷実験を行い、UFC パネルの合成面形状が軸圧縮性状および破壊モードに及ぼす影響について検証した。その結果、RC 柱供試体および UFC・RC 合成柱供試体ともに帯鉄筋間隔の違いによる軸圧縮耐荷力と破壊モードに差異が見られた。また、UFC パネルの合成面形状についてはコンクリート面積比率を高めることで合成面のせん断抵抗性の向上およびコアコンクリートとの付着が高まり一体性を有して軸圧縮力に抵抗することが明らかになった。

キーワード：合成柱, UFC パネル, 合成面形状, 軸圧縮性状, 破壊モード

Journal (掲載誌)

Cement Science and Concrete Technology, Vol. 75, Issue 1, pp. 294–301, 2021.

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Mizuki Fukumura received his master's degree from the Graduate School of Engineering, University of Tokyo in 2012, after which he entered the doctoral course of the same graduate school. He received his DEng degree in March 2018 for his thesis "Methodological Research on Territory and Landscape History in Italy." He served as a part-time lecturer at Tokyo Zokei University in April 2018, and in August 2018, he was employed as a researcher of architectural history at the Iida Institute of Historical Research in Nagano Prefecture. In April 2022, he was employed as an Assistant Professor at the Department of Architecture and Architectural Engineering, College of Industrial Technology, Nihon University, where he is currently working. His primary research fields are architectural history and urban history, with his recent research focusing on the cultural landscapes of southern Nagano Prefecture and their preservation. Dr. Fukumura is a member of the Architectural Institute of Japan (AIJ), the Society of Urban and Territorial History (SUTH), and the *Collegium Mediteranistarium*.

Research Achievements

- 1) Use of Building Registers in Meiji Period for the Analysis of Historical Transformation of Urban Landscape: A case study of former Iida town in Nagano prefecture, *AIJ J. Technol. Des.*, Vol. 31, No. 79, pp. 1654–1659, Oct. 2025. (DOI: <https://doi.org/10.3130/ajjt.31.1654>)
- 2) Re-Evaluation of the Cadastral Maps of Meiji Era for the Historical Landscape Study on GIS, *Rekishigaku Kenkyu* (Journal of Historical Studies), No. 1050, pp. 14–24, Jul. 2024.
- 3) The Re-Definition of the Building Typology in the Post-War Period in Italy: Through the Primary Critical Thoughts of Saverio Muratori in the 1940s, *J. Archit. Plan.* (Trans. AIJ), Vol. 82, No. 738, pp. 2143–2150, Aug. 2017. (DOI: <https://doi.org/10.3130/aija.82.2143>)

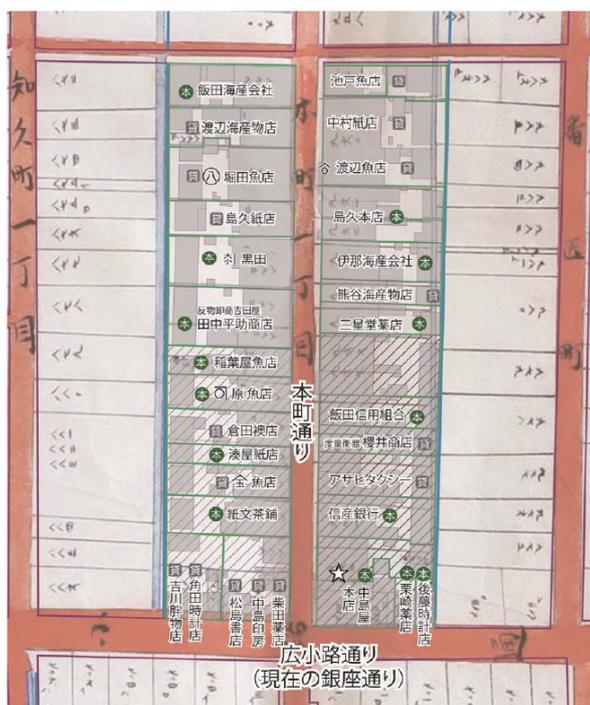


Fig. 1 Drawing of Townscape Reconstruction Around 1930 – Honmachi 1-Chome, Iida City

USE OF BUILDING REGISTERS IN MEIJI PERIOD FOR THE ANALYSIS OF HISTORICAL TRANSFORMATION OF URBAN LANDSCAPE: A case study of former Iida town in Nagano prefecture

Mizuki FUKUMURA

During the surveys of townscapes possessing historical value, prewar administrative documents known as building registers or house registers are frequently utilized alongside actual measurements of extant old houses. The building registers are preserved as documents from former municipal offices and are valuable as official real estate records. However, compared to the old land registers and cadastral maps (land survey maps) created for the purpose of collecting the national land tax, they lack a nationally standardized format and do not cover all former municipalities. The accumulation of research cases remains insufficient when discussing the diverse realities of Meiji-period building registers that still exist throughout Japan. Recent research has suggested various possibilities, such as source criticism considering the development background of the building ledgers and townscape reconstruction using these ledgers. This paper discusses the analysis methods for reconstructing past urban structures and examining the transformation process of urban landscapes through the introduction and interpretation of the “Tatemono Genbo 建物原簿,” a Meiji-period building ledger preserved in Iida city and the Shimoina regions of Nagano Prefecture.

Keywords: Meiji period, building register, house tax, urban fabric, Iida

明治期建物台帳を利用した歴史的都市景観の変容過程の分析 －長野県旧飯田町を事例として－

歴史的価値を有する町並み調査において、現存する古民家の実測調査に加え、建物台帳や家屋台帳と称される戦前の行政資料が活用されることは多い。このような建物台帳の類は、市町村の旧役場文書として伝存しており、不動産に関する公的な記録として貴重ではあるが、国税である地租の徴収を目的として作成された旧土地台帳および旧公図（旧地籍図）と比較すると、全国的に統一された様式や形式をもたず、またすべての旧市町村で作成されたわけではない。日本全国に現存する明治期建物台帳の多様な実態を論じるうえで、研究事例の蓄積はいまだに不十分な状況にある。

近年の研究において、建物台帳の作成背景を踏まえた史料批判や建物台帳による町並み復元など、さまざまな研究の可能性が提示されている。本稿では長野県飯田・下伊那地方に伝存する明治期作成の建物台帳のうち、旧飯田町の「建物原簿」の史料紹介とその読解を通じた、過去の都市組織の復元と都市景観の変容過程の分析方法について論じた。

キーワード：明治期，建物台帳，家屋税，都市組織，飯田

Journal (掲載誌)

AIJ J. Technol. Des., Vol. 31, No. 79, pp. 1654–1659, Oct. 2025. (DOI <https://doi.org/10.3130/aijt.31.1654>)

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Research Achievements

- 1) A Study on the Development of Kampung Improvement Program in Surabaya, Indonesia, 14th International Symposium on Architectural Interchanges in Asia, Kyoto, Japan, Sep. 2024.
- 2) An Examination of Kampung Sustainability and the Determinants of Community Continuity, Summaries of Technical Papers of Annual Meeting, AIJ, Sep. 2023.
- 3) The Role of KIP in the Transition of Kampung in Surabaya, Indonesia and Factors Contributing to the Survival of the Community, Symposium on Community Facilities Planning, Architectural Institute of Japan, Vol. 41, Jun. 2023.
- 4) Study on usage of common space within rumah susun in Surabaya, Indonesia, Japan Architectural Planning, AIJ, Vol. 84, No. 760, pp. 1333–1340, Jun. 2019.
- 5) Study on the Spatial Composition of Rumah Susun (SURABAYA, INDONESIA), The 12th International Symposium on Architectural Interchanges in Asia, Pyeongchang, Korea, Oct. 2018.

Considerations on transformation (1984–2018) of kampung and rumah kampung in Surabaya

Rikako Furuta, Teruki Yamagishi, Kenichi Shinozaki, Naoyuki Hirota, Shuji Funo

This paper clarifies the changes in kampungs and their houses (rumah kampungs) over the past 35 years based on field surveys of three kampungs in Surabaya, Indonesia, conducted in 1983/84, 2006, and 2016–2018. The major objective is to develop new policies for the Kampung Improvement Program (KIP) and public housing. The main finding is that most of the kampungs have maintained their basic spatial structure and community organization, although the houses themselves have been transformed. Thus, kampungs in Surabaya continue to maintain their unique characteristics.

Keywords: Indonesia, Surabaya, Kampung, informal settlements, housing environment, community

スラバヤのカンポンとルーマー・カンポンの変容（1984～2018）に関する考察

本稿は、インドネシア・スラバヤの3つのカンポンにおいて、1983/84年、2006年、2016–2018年に実施したフィールド調査に基づき、過去35年間におけるカンポン（インフォーマル居住地）とその住宅（Rumah kampung）の変容を明らかにするものである。インドネシア・スラバヤでは低所得者層の居住地を対象として、カンポン改善プログラム（KIP）および住宅供給政策がこれまで行われてきている。調査の結果、多くのカンポンが基本的な空間構造やコミュニティ組織を35年間、保持していることがわかった。一方で住宅については、その時代ごとに居住者によって環境を変化させながらも住み続けていることが明らかとなった。インドネシアではこの間、大きな国家的政策により、急速な経済成長を遂げている。それにもかかわらず、スラバヤのカンポンは独自の特性を変えずに保持し、カンポンの文化や歴史を継承しながらカンポンを展開してきている。

キーワード：インドネシア、スラバヤ、カンポン、インフォーマル居住地、住居環境、コミュニティ

Journal（掲載誌）

Japan Architectural Review, Vol. 6, Issue 1, Oct. 2022.

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Research Achievements

- 1) Development of Evaluation Method of Covering Condition for Silica-Coated Cellulose Composites, *J. Soc. Inorg. Mater.*, Japan, Vol. 32, pp. 243-248, Nov 2025.
- 2) Controlling Particle Diameter Method of Opal as Standard Sample of Hazardous Mineral for Alkali Silica Reaction, *J. Soc. Inorg. Mater.*, Japan, Vol. 29, pp. 85-88, 2022.
- 3) Instant Strong Adhesive Behavior of Nanocomposite Gels toward Hydrophilic Porous Materials, *Langmuir*, Vol. 34, pp. 8480-8488, 2018.
- 4) Quantitative Analysis of Amorphous Silicon Dioxide Using Profile Fitting Method, *J. Soc. Inorg. Mater.*, Japan, Vol. 21, pp. 123-127, 2014.
- 5) Soft Chemical Synthesis and Characterization of Superconductor and Related Materials, *J. Soc. Inorg. Mater.*, Japan, Vol. 17, pp. 252-256, 2010.

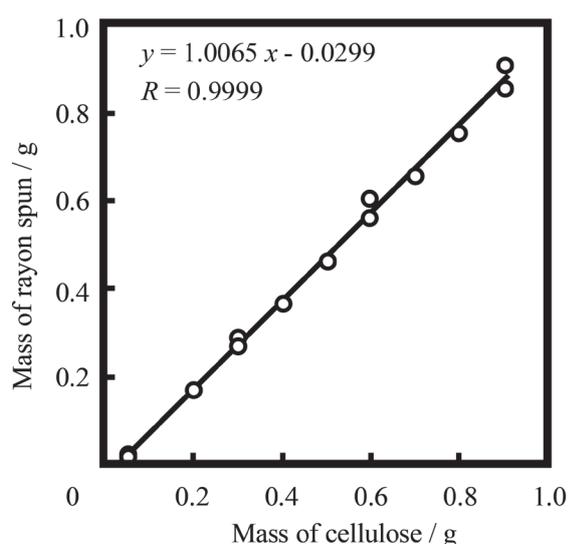


Fig. 1 Mass of rayon spun obtained at various mass of cellulose in system of SR#3¹⁾.

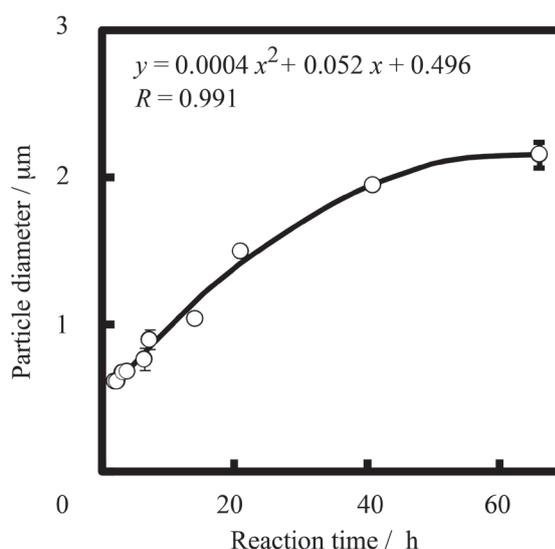


Fig. 2 Influence of particle diameter of obtained opal on reaction time²⁾.

Development of Evaluation Method of Covering Condition for Silica-coated Cellulose Composites

Satoshi TANAKA, Shinnosuke HAYASHI and Keisuke MASUBUCHI

This paper describes the improved heat resistance of cellulose in relation to cellulose nanofibers (CNFs), which are gaining attention as a next-generation material that can contribute to the realization of a sustainable society. The diverse characteristics of CNFs, such as a high specific surface area, edibility, light weight, high strength, low thermal expansion, biodegradability, and biocompatibility, have made them an attractive alternative to fossil-fuel-derived plastics. Increasing the types and quantities of plastics that can be replaced by CNFs will contribute to the sustainable and advanced application of CNFs. Improving the heat resistance of CNFs will enable the expansion of applications for CNF composite resins, further contributing to the sustainable and advanced application of CNFs. Based on this concept, the goal of this research is to improve the heat resistance of CNFs by coating them with a highly heat-resistant substance. Previous reports examining the heat resistance of silica-coated cellulose composites have shown that complete coating of CNFs contributes to improving their heat resistance. However, there have been no reports on methods for determining the complete coating of cellulose with specific substances such as silica. In this study, we investigated a method for evaluating the degree of coating of a composite in which cellulose is coated with a highly heat-resistant substance such as silica. This method was developed by utilizing the solubility of cellulose in Schweitzer's reagent and the stoichiometric formation of one mole of rayon from one mole of cellulose. Using three types of Schweitzer's reagent with different solution compositions as raw materials, a method for determining the complete coating of cellulose with silica was investigated. This method was found to be effective for determining the silica coating of silica-coated cellulose composites.

Keywords: Cellulose nanofibers, heat resistance, cellulose, silica coating, Schweitzer's reagent

シリカ被覆セルロース複合体の被覆判定方法の開発

この論文は次世代材料として注目されている CNF に関連したセルロースの耐熱性向上について述べている。持続可能な社会の実現に貢献する次世代素材として、セルロースナノファイバー（以下、CNF と記す）が注目されている。CNF は高比表面積、可食性、軽量、高強度、低熱膨張性、生分解性、生体適合性などの特徴を有する。このような多様な特徴から、化石燃料由来のプラスチックの代替材料として注目されている。CNF で代替できるプラスチックの種類と量を増やすことが CNF の持続可能な発展的な応用に寄与する。CNF の耐熱温度を向上することで、CNF 複合樹脂の使用用途を拡大することが可能となり、ひいては、CNF の持続可能な発展的な応用に寄与することとなる。このような考えのもと、CNF を耐熱性の高い物質で被覆し、CNF の耐熱性の向上を本研究の目標とする。

シリカ被覆セルロース複合体の耐熱性について検討した既往の報告によると、CNF を完全に被覆することが CNF の耐熱性向上に寄与することになる。しかし、シリカのようなある物質でセルロースが完全に被覆されたことを判定する方法についての報告は皆無である。本報告では、シリカのような耐熱性の高い物質でセルロースを被覆した複合体の被覆度合いを評価するための方法について検討した。この方法は、セルロースが Schweitzer 試薬に溶解する性質ならびに 1 モルのセルロースから 1 モルのレーヨンが化学量論的に生成する性質を利用して開発された方法である。原料溶液組成の異なる 3 種類の Schweitzer 試薬を用い、シリカでセルロースが被覆されたことを判定する方法について検討した。本方法がシリカ被覆セルロース複合体のシリカ被覆の判定方法として有効であることを明らかにした。

キーワード：セルロースナノファイバー、耐熱性、セルロース、シリカ被覆、シュバイツァー試薬

Journal (掲載誌)

J. Soc. Inorg. Mater., Japan, Vol.32, 243-248, Nov 2025.

Taka-aki HOSHINA

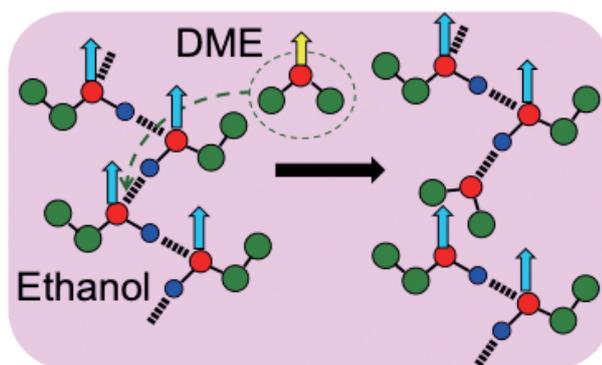
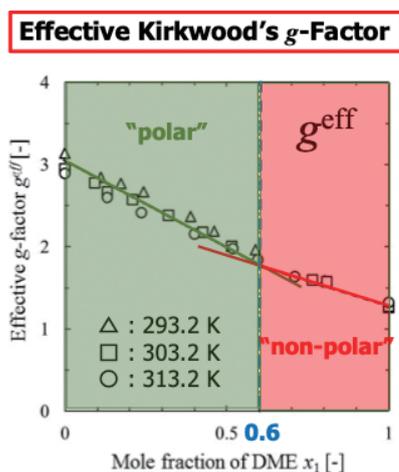
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Taka-aki Hoshina is an Associate Professor at the Department of Applied Molecular Chemistry, College of Industrial Technology, Nihon University. He received his BLA in Engineering from Doshisha University in 2000, his MSc in 2002, and his PhD in 2005. His main project at Doshisha University was the study of ionic mobilities in sub- and supercritical methanol. Dr Hoshina worked as a Researcher at Doshisha University from April to June 2005. From 2005 to 2007, he worked as a Postdoctoral Fellow at the Research Centre of Supercritical Fluid Technology, Tohoku University Graduate School of Engineering. He was an Assistant Professor at the Tohoku University Graduate School of Engineering from 2007 to 2009 and a Global COE Fellow from 2009 to 2010. His main project at Tohoku University was the density and dielectric permittivity of binary solutions at high temperature and high pressure. Since 2010, he has been working at the College of Industrial Technology, Nihon University, where his main projects focus on the physical properties (phase equilibrium, dielectric properties, density, viscosity, electric conductivity, etc.) of solvents for aerosol spray and for carbon dioxide absorption. He was a mentor of the International Chemistry Olympiad in Great Britain in 2009. In 2023, he traveled to the University of Western Australia (UWA) as an overseas researcher of Nihon University. His project at the UWA involved measuring and correlating the static permittivity of refrigerants. He is a member of the Society of Chemical Engineers, Japan (SCEJ), the Society of Separation Process Engineers, Japan (SSPEJ), the Society of Sea Water Science, Japan, the Japan Society of Thermophysical Properties (JSTP), and the Japan Society of High-Pressure Science and Technology (JSHPST).

Research Achievements

- 1) Bubble point pressure measurement and prediction of VLE and VLLE for dimethyl ether–2-butoxyethanol and dimethyl ether–water–2-butoxyethanol at (293.15–313.15) K, *Fluid Phase Equilibria*, Vol. 592, 114320, 2025.
- 2) Volumetric and dielectric properties in liquid phase of dimethyl ether–ethanol at (293.2–313.2) K and 1.00 MPa, *Journal of Solution Chemistry*, Vol. 53, pp. 278–293, 2024.
- 3) Measurement and prediction of bubble point pressure of a novel solvent with propellant for color spray, *Fluid Phase Equilibria*, Vol. 505, 112366, 2020.
- 4) CO₂ absorption effect on electric conductivities for butylethanolamine and methyl diethanolamine aqueous solutions at 313 K (in Japanese), *Bunseki Kagaku*, Vol. 68, pp. 647–655, 2019.



The effective g -factor decreased with increasing DME. The molecular orientation will be randomised and changed to a non-polar solution around $x_1 = 0.600$.

Volumetric and Dielectric Properties in Liquid Phase of Dimethyl Ether – Ethanol at (293.2–313.2) K and 1.00 MPa

Taka-aki HOSHINA, Kazunori SATO, Masaki OKADA, Tomoya TSUJI, and Toshihiko HIAKI

This paper describes the solvent structure and molecular orientation in a liquefied dimethyl ether (DME)–ethanol mixture, based on the results of the DME dependence of the density and dielectric properties (static permittivity and dielectric relaxation time) at (293.2–313.2) K and 1.00 MPa. The density of binary mixtures has been determined by measuring the oscillation periods of vibrating tubes filled with the solutions. The dielectric properties, on the other hand, have been determined by correlating the complex dielectric spectra measured with the single-phase Debye equation. The DME dependence of the measured mixture density decreased with an increase in the DME concentration and temperature. The excess molar volume was negative across the entire DME concentration range. This indicates that attractive interaction among the molecules is essential in the liquefied DME–ethanol mixture at (293.2–313.2) K and 1.00 MPa. The DME dependence of the static permittivity and dielectric relaxation time for the studied mixture decreased with an increase in the DME concentration and temperature at (293.2–313.2) K and 1.00 MPa. Experimental results showed that the excess values of the static permittivity are negative, with the DME composition dependence being negative. This may indicate that the dipole orientation plays a dominant role in DME–ethanol at (293.2–313.2) K and 1.00 MPa. The effective Kirkwood g -factor was evaluated at 293.2–313.2 K and 1.00 MPa. The g -factors were given by two linear functions crossing at around 0.6 for the mole fraction of DME. Considering the atomic composition (C_2H_6O), the molecular sizes are not significantly different between DME and ethanol. The solution structure was thought to be microscopically changed around 0.6 for the mole fraction of DME.

Keywords: Dimethyl ether, ethanol, volumetric behavior, dielectric properties, solution structure

293.2–313.2 K, 1.00 MPa における液相中の ジメチルエーテル - エタノール系の体積および誘電物性

本論文では、(293.2–313.2) K, 1.00 MPa における液化ジメチルエーテル (DME) – エタノール系の密度および誘電物性 (比誘電率および誘電緩和時間) を測定し、これらの DME 組成依存性を調べ、溶媒構造および分子配向について述べている。密度は振動管に溶液を充填し、振動周期を測定して決定した。誘電物性は複素誘電スペクトルを測定し、周波数依存性を単相 Debye 式で相関して求めた。(293.2–313.2) K, 1.00 MPa における液化 DME–エタノール系の密度は、DME 組成および温度の上昇に伴って単調に減少した。過剰モル体積はすべての DME 組成で負の値を示した。(293.2–313.2) K, 1.00 MPa における液化 DME–エタノール系では、分子間の引力的相互作用が支配的であることを示唆している。比誘電率および誘電緩和時間の DME 依存性も、DME 組成および温度の増加に伴い減少した。(293.2–313.2) K, 1.00 MPa における実験値から求めた比誘電率の過剰値の DME 組成依存性は負であることが示された。本実験条件における液化 DME–エタノール系では、溶液中の分子の双極子モーメントの配向が支配的な役割を果たしていることを示唆している。このことを調べるために Kirkwood の有効 g -factor を 293.2–313.2 K, 1.00 MPa において評価したところ、 g -factor の DME 組成依存性は、DME のモル分率約 0.6 の付近で交差する 2 本の直線的な傾向を示した。DME とエタノールは同じ示性式 (C_2H_6O) を持つため分子サイズに大きな差はない。DME モル分率 0.6 付近で、溶液構造が微視的に変化していると考えられる。

キーワード：ジメチルエーテル, エタノール, 体積挙動, 誘電物性, 溶液構造

Journal (掲載誌)

The Journal of Solution Chemistry, Vol. 53, 278–293, Feb. 2024.

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Research Achievements

- 1) EVI-GPBO: Estimated Variance Integration-Based Gaussian Process Bayesian Optimization, IEEE Access, Vol. 13, pp. 26208–26224, Feb. 2025.
- 2) Multi-Rules Mining Algorithm for Combinatorially Exploded Decision Trees With Modified Aitchison-Aitken Function-Based Bayesian Optimization, IEEE Open Journal of the Computer Society, Vol. 5, pp. 215–226, 2024.
- 3) Theoretical Analysis of the SIRVVD Model for Insights into the Target Rate of COVID-19/SARS-CoV-2 Vaccination in Japan, IEEE Access, Vol. 10, pp. 43044–43054, Apr. 2022.
- 4) E2H Distance-Weighted Minimum Reference Set for Numerical and Categorical Mixture Data and a Bayesian Swap Feature Selection Algorithm, Machine Learning and Knowledge Extraction, Vol. 5, No. 1, pp. 109–127, Jan. 2023.
- 5) Features gradient-based signals selection algorithm of linear complexity for convolutional neural networks, AIMS Mathematics, Vol. 9, No. 1, pp. 792–817, Jan. 2024.

EVI-GPBO: Estimated Variance Integration-Based Gaussian Process Bayesian Optimization

Yuto Omae, Yohei Kakimoto, Makoto Sasaki, Masaya Mori

Upper confidence bound based Gaussian process Bayesian optimization (UCB-GPBO) is a metaheuristic algorithm for approximately exploring the optimal solution of black-box functions with high observation costs. UCB-GPBO has recently attracted significant attention because it is expected to greatly reduce the number of experiments required for discovering new materials and developing new medicines. This method determines the next observation point based on two components: the exploitation term E , which prioritizes regions where good results are expected, and the exploration term V , which prioritizes regions with high uncertainty. Traditionally, the exploration coefficient used to balance E and V has been set as a constant or logarithmically decaying function. However, these approaches are often inadequate and can reduce the exploration performance. To address this problem, we propose a novel Bayesian optimization method, “Estimated variance integration based GPBO (EVI-GPBO),” which reflects the overall uncertainty of the search space in the exploration coefficient. In this approach, we analytically derive the integral of the estimated variance function represented by the kernel function, thereby obtaining a closed-form function for quantifying the uncertainty. Experimental comparisons between the proposed method and existing methods on several benchmark problems demonstrated that in many cases, the proposed method achieves better solutions with fewer observations. Therefore, EVI-GPBO can be regarded as an effective metaheuristic algorithm.

Keywords: Bayesian optimization, surrogate optimization, Gaussian process, approximation algorithm

EVI-GPBO: 推定分散積分に基づくガウス過程ベイズ最適化

上側信頼境界に基づくガウス過程ベイズ最適化 (UCB-GPBO) は、観測コストが高いブラックボックス関数の最適解を近似的に探索するためのメタヒューリスティックアルゴリズムである。UCB-GPBO は、新材料の発見や新薬の開発に必要な実験回数を大幅に削減できると期待されており、近年注目を集めている。この手法は、良い結果が期待できる場所を観測しようとする活用項 E と、結果の不確実性が大きい場所を観測しようとする探索項 V によって、次に観測すべき点を決定する。ここで、活用項 E と探索項 V のバランスを調整する探索係数には、従来は定数や対数減衰がよく使われてきた。しかし、これらの方法は妥当性が低く、探索性能を下げる要因となることがあった。この問題を解決するため、本研究では探索空間全体の不確実性を探索係数に反映させる新しいベイズ最適化手法 “Estimated Variance Integration-based GPBO (EVI-GPBO)” を提案する。提案手法では、カーネル関数で表現された推定分散関数を積分し、その解析解を用いて不確実性を定量化するための閉形式関数を導出した。いくつかのベンチマーク課題で提案手法と既存手法を比較した結果、多くの課題において、提案手法の方が少ない観測回数でより良い解を得られることが確認された。以上から、EVI-GPBO は有効なメタヒューリスティックアルゴリズムであると考えられる。

キーワード：ベイズ最適化, サロゲート最適化, ガウス過程, 近似アルゴリズム

Journal (掲載誌)

IEEE Access, Vol. 13, pp. 26208–26224, Feb. 2025.

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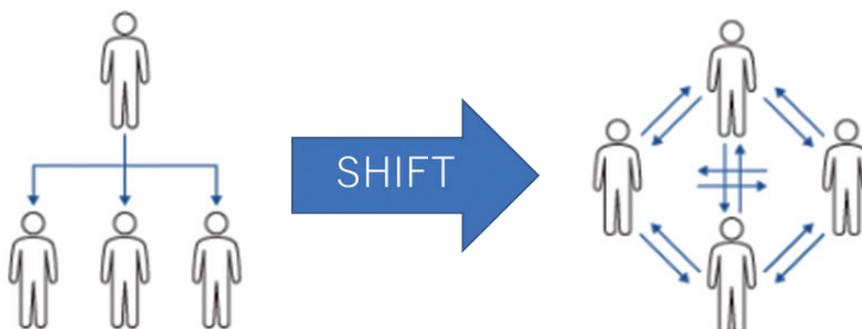


Shiho Horio is an Assistant Professor at the Department of Industrial Engineering and Management, College of Industrial Technology of Nihon University. Dr. Horio received her PhD in Business Administration from Rikkyo University in 2024. From 2000 to 2025, she worked at JMA Management Center Inc. (JMAM), conducting research on personnel assessment and development of a wide range of educational programs for personnel ranging from employees to managers and executives. At JMAM, she collaborated with overseas research institutions such as the Center for Creative Leadership, and engaged in activities to disseminate in Japan the latest research trends from these overseas institutions. She also held the position of Director in the Program Development Division at JMAM. In 2025, she joined Nihon University where she is engaged in research and education in the fields of organizational behavior and human resource management. She is a member of academic societies including the Japanese Association of Industrial/Organizational Psychology (JAIOP), the Japanese Association of Administrative Science (JAAS), the Academic Association for Organizational Science (AAOS), and the Japan Association of Applied Psychology (JAAP).

Research Achievements

- 1) Shiho HORIO, Jun NAKAHARA. A Study on the Behavioral Process of Corporate Managers to Foster Shared Leadership of Their Jurisdictional Teams, *Japan Journal of Human Resource Management*, Vol. 24(2), pp. 21–41, 2023.
- 2) Shiho HOIRO, Jun NAKAHARA. Trends and Prospects in Shared Leadership Studies: Focusing on Antecedent and Moderator Factors Studies, *Japanese Association of Industrial/Organizational Psychology Journal*, Vol. 36(1), pp. 29–52, 2022.
- 3) Shiho HORIO, Kiyoshi TAKAHASHI. Roles of Social Desirability Scales of The Big-Five Personality Inventory in Faking Settings, *Japanese Association of Industrial/Organizational Psychology Journal*, Vol. 17(2), pp. 65–77, 2004.

Forms of Leadership



Dr. Horio's research focuses on shared leadership, which examines leadership styles within organizations not only vertically but also horizontally.

Trends and Prospects in Shared Leadership Studies: Focusing on Antecedent and Moderator Factors Studies

Shiho HORIO and Jun NAKAHARA

The purpose of this study is to identify gaps in existing research on shared leadership, particularly by examining its antecedent and moderator factors, and to explore future directions for research in this area. A comprehensive scoping review was conducted to classify and evaluate existing studies, which revealed specific research gaps within four research groups: (1) antecedents focusing on vertical leader factors, (2) antecedents focusing on non-vertical leader factors, (3) moderators focusing on non-vertical leader factors, and (4) moderators focusing on vertical leader factors. In Group 1, there is a lack of research on the processes and mechanisms through which vertical leaders' behaviors positively influence shared leadership. In Group 2, insufficient attention has been paid to organizational-level antecedents and the interrelationships among various antecedents already identified. Group 3 lacks studies that investigate the commonalities necessary to effectively leverage diversity among team members, as well as research examining how external environmental factors moderate shared leadership. Notably, Group 4 had no existing studies, indicating a significant gap in understanding how vertical leader factors might function as moderators. These findings indicate that while prior research has shed light on many antecedent and moderator variables, substantial areas remain underexplored. Based on these gaps, this study discusses potential future research directions that could advance the field by addressing these overlooked areas and developing a more integrated understanding of the dynamics of shared leadership in organizational settings.

Keywords: Shared leadership, shared leadership development, team, innovation, scoping review

共有型リーダーシップ研究の動向と展望 —先行要因・モデレータ要因研究に着目して—

本研究の目的は、近年注目を集めている共有型リーダーシップ（シェアード・リーダーシップ）に関し、特にその形成要因（先行要因）および影響を調整する要因（モデレータ要因）に焦点を当てて体系的に検討を行い、現時点で残されている主要な研究課題を明らかにするとともに、今後さらに研究が進められるべき領域について展望することである。本研究ではスコピングレビューの手法に基づいて文献を詳細に検討し、既存研究を分析・整理した結果、以下の4つの研究グループに分類され、それぞれにおいて特有の研究ギャップが存在していることが明らかになった。分類された研究グループは、1. 垂直的リーダー（フォーマルなリーダー）の要因に焦点を当てた先行要因研究グループ、2. 垂直的リーダー要因以外の要因に焦点を当てた先行要因研究グループ、3. 垂直的リーダー要因以外の要因に焦点を当てたモデレータ要因研究グループ、4. 垂直的リーダー要因に焦点を当てたモデレータ要因研究グループである。グループ1では、垂直的リーダーによる具体的なリーダーシップ行動が、どのようなプロセスやメカニズムを通じてチーム内の共有型リーダーシップを促進するのかについての実証的研究の不足が特定された。グループ2では、組織レベルの構造的・文化的要因が共有型リーダーシップの形成に与える影響に関する研究が乏しく、また、これまでに特定された複数の先行要因同士の相互関係、特に遠位要因と近位要因の因果関係に着目した研究の不足が特定された。グループ3では、チームメンバー間の多様性を有効に活かすために必要とされる共通認識や価値観といった「共通性」に関する検討が不足していたほか、チームが置かれる外部環境（市場変化、技術的变化、競争状況など）が共有型リーダーシップに与える調整効果に関する知見も極めて限定的であった。グループ4については、該当する研究そのものが確認されておらず、完全に未開拓の領域であることが判明した。以上のような既存研究のギャップに基づき、本研究では、今後の共有型リーダーシップ研究が進展するために必要な視点やアプローチについて、いくつかの具体的な方向性を提示している。

キーワード：共有型リーダーシップ, 共有型リーダーシップ開発, チーム, イノベーション, スコピングレビュー

Journal (掲載誌)

Japanese Association of Industrial/Organizational Psychology Journal, Vol. 36, No. 1, pp. 29–52, 2022

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Research Achievements

- 1) Numerical analysis of miter bend with spiral phase mirror, *Journal of Advanced Simulation in Science and Engineering*, Vol. 12(2), pp. 329–339, Jul. 2025.
- 2) Prediction of spatial X-ray dose distribution using pix2pix-based model, *Journal of Advanced Simulation in Science and Engineering*, Vol. 12(1), pp. 179–190, Apr. 2025.
- 3) Numerical analysis of optical vortex generation with helical filter using empirical mode decomposition, *International Journal of Applied Electromagnetics and Mechanics*, Vol. 78(4), pp. 332–340, Apr. 2025.
- 4) Generating optical vortex beams using cylindrical waveguides, *Japanese Journal of Applied Physics*, Vol. 63(10), 10SP07, 2024.
- 5) Interactive Restoration of Three-Dimensional Implicit Surface with Irregular Parts, *Computer Modeling in Engineering & Sciences*, Vol. 136(3), pp. 2111–2125, Mar. 2023.

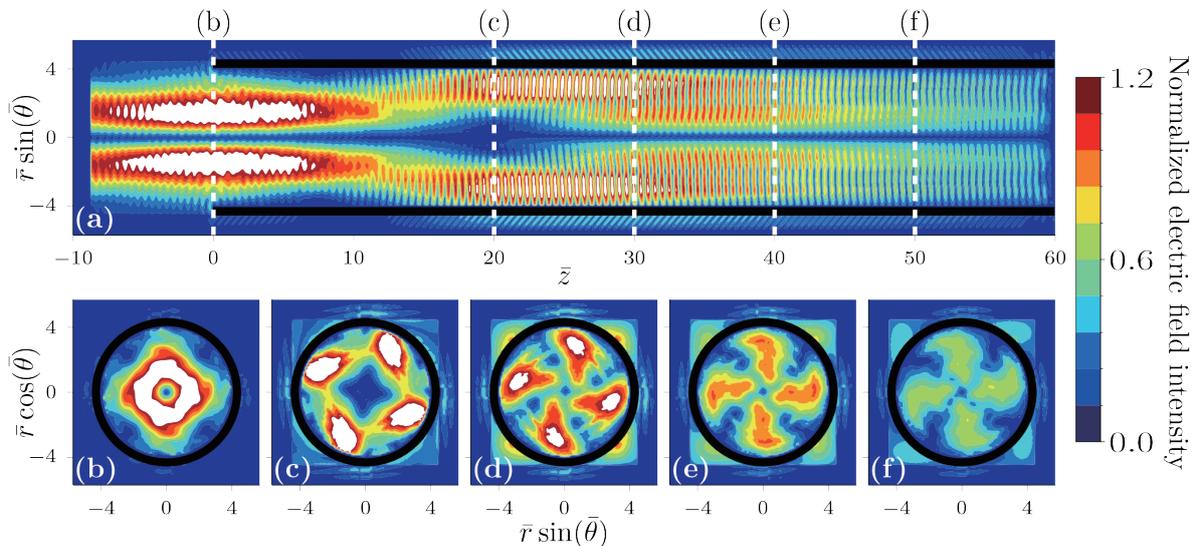


Fig. 1 Normalized electric field intensity $|\vec{E}|$ in a waveguide with four offset-tilted Gaussian beams. The black area indicates the metal portion of the waveguide. © 2024 JSAP

Generating optical vortex beams using cylindrical waveguides

Yoshihisa FUJITA, Hiroaki NAKAMURA, Hideki KAWAGUCHI, Yuki GOTO, and Shin KUBO

This paper proposes a method for generating vortex modes within a cylindrical waveguide using Gaussian beams. In plasma heating, conventional plane waves cannot propagate beyond the cutoff density, whereas optical vortices can potentially overcome this limitation, offering improved heating efficiency. Although various methods for exciting optical vortices have been proposed, most of them rely on interactions with a medium. High-power millimeter waves used in plasma heating cannot neglect Joule losses, and practical applications require long-distance wave transmission. Therefore, developing an efficient excitation method compatible with existing transmission lines is crucial. Corrugated waveguides, commonly used for high-power millimeter-wave transmission, support hybrid modes. Here, higher-order waveguide modes with helical phase fronts are defined as vortex modes. Normally, the fundamental mode is excited by injecting a Gaussian beam along the waveguide axis; however, misalignment can unintentionally excite higher-order modes. This study aimed to actively control these higher-order modes to generate arbitrary vortex modes. For simplicity, a cylindrical waveguide with smooth walls was considered, and the metal was assumed to be a perfect conductor. The coupling between tilted and offset Gaussian beams and specific waveguide modes was analyzed to determine the optimal tilt angles and offsets. Numerical simulations demonstrated that four Gaussian beams can efficiently excite the vortex modes, and increasing the number of beams further enhances the excitation efficiency.

Keywords: Optical vortex, high-power millimeter wave, mode coupling, waveguide mode

円筒導波路を用いた光渦ビームの生成

本論文では、ガウスビームを用いて円筒形導波管内に渦モードを誘起する手法を提案する。プラズマ加熱において、従来の平面波は臨界密度を超えて伝播できないが、光渦はこの制限を克服し加熱効率を向上させる可能性を秘めている。光渦の励起方法についてはこれまでに様々な手法が提案されているが、その多くは媒質との相互作用に依存している。一方、プラズマ加熱に用いられる電磁波は大電力ミリ波であり、媒質中でのジュール損失を無視することはできない。また、実際の運用では電磁波を長距離伝送する必要もある。そこで、本研究では既存の伝送路を利用した新たな光渦励起法を提案する。

大電力ミリ波の伝送にはコルゲート導波管が広く用いられ、その導波管モードはハイブリッドモードとして知られている。本研究では、螺旋状の位相面をもつ高次導波管モードを渦モードと定義する。通常は導波管の光軸に沿ってガウスビームを入射することで基本モードが励起されるが、光軸のずれにより高次モードが意図せず励起されることが知られている。そこで本研究では、この高次モードを能動的に制御することで任意の渦モードを励起することを目指した。

解析の簡略化のため、本研究では滑らかな壁面を有する円筒導波管を対象とし、金属を完全導体と仮定した。傾斜およびオフセットを与えたガウスビームと特定導波管モードとの結合を検証し、最適な傾斜角とオフセット値を導出した。さらに数値シミュレーションにより、4本のガウスビームを用いることで渦モードを効率的に励起できることを示した。加えて、ガウスビームの本数を増やすことで励起効率が一層向上することを確認した。

キーワード：光渦，大電力ミリ波，モード結合，導波管

Journal (掲載誌)

Japanese Journal of Applied Physics, Vol. 63(10), 10SP07, 2024.

Kosuke ZAITSU

Assistant Professor, Department of Mathematical Information Engineering



Kosuke Zaitzu is an Assistant Professor at the Department of Mathematical and Information Engineering, College of Industrial Technology, Nihon University. In 2018, he received his PhD from Kyushu University, where he completed his dissertation on the evaluation of serious games for healthcare targeting the elderly. In 2020, he started working at the University of Tokyo as a Project Researcher conducting surveys of instructors implementing game-based learning in collaborative projects with game-related companies. He moved to Nihon University in 2024, where he conducts studies and research with keywords including game-based learning, serious games, and game design.

Research Achievements

- 1) Creating a pattern language to support game-based learning practice in online environments, *Journal of Digital Games Research*, Vol. 16, No. 1, 2023.
- 2) Design Proposal for Unilateral Spatial Neglect Rehabilitation Training Game – Through Production and Verification of “Tatake! Bang Bang Master,” *Journal of Digital Games Research*, Vol. 12, No. 1, 2019.
- 3) Association Between Extraversion and Exercise Performance Among Elderly Persons Receiving a Videogame Intervention, *Games for Health Journal*, Vol. 4, No. 5, 2015.

Creating a pattern language to support game-based learning practice in online environments

Kosuke ZAITSU and Toru FUJIMOTO

This study aims to create a pattern language to support practitioners who intend to introduce game-based learning in online environments. Interviews were conducted with four instructors currently practicing game-based learning at an online school for digital games. We created a pattern language comprising 18 patterns to support the introduction of game-based learning. A workshop was conducted using the prototype of the pattern language. The results indicated that workshop with these patterns is useful for sharing and exchanging practical knowledge regarding game-based learning among instructors.

Keywords: Game-based learning, pattern language, workshop, instructor support

オンライン環境におけるゲーム学習支援のための パターン開発とワークショップ実践

本研究では、ゲーム学習を教育現場に導入する実践者を支援するツール作成の試みとして、オンライン環境でデジタルゲームをプレイする際の学習支援者の実践知を共有するためのパターンを作成した。デジタルゲームのオンライン学習塾にてゲーム学習の実践を行っている講師4名を対象にインタビューを実施し、18個からなる「ゲーム学習支援パターン」を試行的に開発した。開発したパターンを用いた対話型の実践知共有ワークショップを実施した。実施後のアンケートから、パターンを用いたワークショップは、ゲーム学習に関する実践知の共有や、講師同士で相互に経験則を交換しあうことに有効であることが確認された。

キーワード：ゲーム学習、パターン・ランゲージ、ワークショップ、教員支援

Journal (掲載誌)

Journal of Digital Games Research, Vol. 16, No. 1, 2023.

Keiko NAGAMURA

Associate Professor, Department of Sustainable Engineering



Keiko Nagamura is an Associate Professor at the College of Industrial Technology, Nihon University. After working at Japan Cultural Heritage Consultancy Co., Ltd., where she engaged in cultural heritage conservation, she joined academia and collaborated with municipalities at Kyushu University on projects for urban revitalization, landscape planning, and comprehensive planning. Since joining Nihon University in 2016, she has advanced practical research integrating community participation, regional resource management, and heritage-based town design. Her current studies apply the behavioral change theory and nature-based solutions (NbS) to promote sustained citizen participation in environmental conservation. Building on award-winning initiatives such as the Yatsu Wetland Project in Tomisato City (2024 JSCE Environmental Award) and the JR Yanagigaura Station Redevelopment Project (Good Design and Wood Design Awards), Dr. Nagamura bridges academia and local practice. She values fieldwork and dialogue with residents, working with students to co-create sustainable public spaces.

Research Achievements

- 1) Challenges and Current Conditions in Lawn Evaluation of Urban Parks Managed by Local Governments – Focusing on Target-Reality Gaps and Management Systems in Chiba Prefecture, *Journal of the City Planning Institute of Japan*, Vol. 60, No. 3, pp. 743–750, 2025.
- 2) Community Design for the Conservation and Succession of Local Heritage Resources, 10th Anniversary International Symposium of Tomioka Silk Mill and Related Sites (ICOMOS Japan, Gunma Prefecture), 2025.
- 3) Visualization and Succession of Memory Heritage Using Integrated Model Viewer, JSCE Annual Meeting (Division of Civil Engineering History), IV-74, 2024.
- 4) Landscape-Oriented Infrastructure Design Using BIM/CIM Tools: The Case of Seimou Highway in An-naka City, JSCE Annual Meeting (Transportation Division), VI-50, 2024.
- 5) Citizen Participation Program for Roadside Vegetation Management, JSCE Annual Meeting (Transportation Division), VI-55, 2024.



Students and residents collaborating in a community design workshop and meeting



Community engagement using BIM/CIM visualization tools

Community Design for the Conservation and Succession of Local Heritage Resources

Keiko NAGAMURA

This paper explores the “Memory Heritage Project,” a community-driven initiative aimed at preserving and transmitting modern heritage in Japan. The project focuses on the value of local memories and their role in heritage conservation. By engaging local residents in the process of uncovering and sharing their personal and collective memories related to modern heritage sites, the project fosters a sense of community and shared responsibility for heritage preservation. The study highlights the importance of “genealogy evaluation,” which assesses the historical, cultural, and social significance of heritage sites from a local perspective. This approach emphasizes the interconnectedness of heritage, community, and sustainable development. The project has been implemented in various regions, including the Aburatsu area in Miyazaki Prefecture, where it has successfully revitalized local communities and enhanced the appreciation of modern heritage. Key findings include the role of community participation in heritage conservation, the impact of shared memories on the perceived value of heritage sites, and the potential of such projects to contribute to sustainable community development. This paper also discusses the challenges and opportunities associated with the “Memory Heritage Project,” providing insights into how similar initiatives can be adapted and implemented in other regions. By examining the formation and role of heritage communities, the paper contributes to the broader discourse on heritage ecosystems and the sustainable management of cultural heritage. The findings underscore the need for an integrated approach that combines tangible and intangible heritage, community engagement, and innovative conservation strategies.

Keywords: Memory Heritage Project, Civil engineering heritage, genealogy evaluation, community participation

地域の歴史資源を保全・継承するコミュニティデザイン

本論文では、筆者が提案し、日本の地域で実践を重ねている「記憶プロジェクト」を紹介する。これは、人々の記憶と地域の歴史資源に焦点を当て、住民が主体的に参加する機会を提供する取組である。地域遺産にまつわる個人や集団の記憶を掘り起こし、共有することを通じて、遺産保全に対する共同体意識と共有責任を育んでいる。研究では、土木学会が提示する土木遺産評価の三要素のうち「系譜」に着目し、地域コミュニティの視点から遺産の歴史的・文化的・社会的意義を考察する。この「系譜評価」のアプローチは、地域遺産とコミュニティの持続可能性を結び付ける枠組みとして有効である。本プロジェクトは宮崎県日南市油津地区で試行され、地域コミュニティの再生と地域遺産への理解の深化に寄与した。研究の成果として、遺産保全における市民参画の重要性、共有記憶が遺産価値の認識に与える影響、そして地域の持続的発展に向けたこうした取組の可能性を示している。また、有形・無形の遺産、コミュニティ参加、創造的手法を統合したアプローチの意義を明らかにし、他地域への応用可能性を提示している。

キーワード：記憶遺産プロジェクト，土木遺産，系譜評価，市民参画

Exhibition (国際シンポジウム)

10th Anniversary International Symposium of Tomioka Silk Mill and Related Sites (ICOMOS Japan, Gunma Prefecture), 2025

Iku SAITO

Assistant Professor, Department of Sustainable Engineering



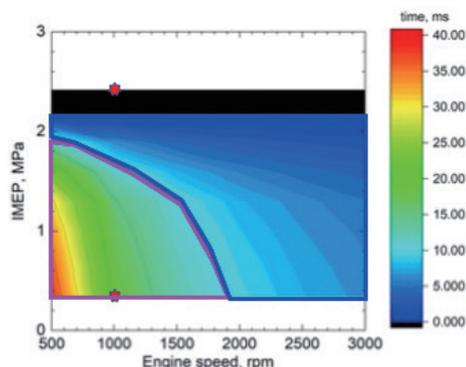
Iku Saito is an Assistant Professor at the Department of Sustainable Engineering, College of Industrial Technology, Nihon University. He received his master's degree from the Graduate School of Nihon University in 2016. Following graduation, he worked on the research and development of engines and after-treatment systems at Hino Motors, Ltd. He was awarded his doctoral degree from Nihon University in 2023; his doctoral thesis was "Study on NO_x conversion using reformed gas of hydrocarbon fuel produced by low temperature oxidation reaction." In 2024, he began his academic career at the College of Industrial Technology, Nihon University. His research interests include internal combustion engines, combustion, after-treatment technologies, and catalysts. Dr. Saito is a member of the Combustion Society of Japan, the Japan Society of Mechanical Engineers (JSME), and the Japan Society of Automotive Engineers (JSAE).

Research Achievements

- 1) Iku SAITO, Hodaka SANO, Hiroshi NOMURA, Yusuke SUGANUMA, Effect of products of low temperature oxidation reaction on NO_x reduction in HC-SCR system, Proc. Combust. Inst., Vol. 39, pp. 4881–4888, 2024. (DOI: 10.1016/j.proci.2022.07.250)
- 2) Iku SAITO, Shogo SHINKAI, Hiroshi NOMURA, Yusuke SUGANUMA, Development of forced cool-flame ignition and detection device for a fuel droplet, Int. J. Microgravity Sci. Appl., Vol. 39, 2022. (DOI: 10.15011/jasma.39.390303)
- 3) Iku SAITO, Shinya SATO, Hiroshi NOMURA, Yusuke SUGANUMA, Haruka MISAKA, Development of HC-SCR System by Diesel Reformed Gas Using a Low Temperature Oxidation, Transactions of Society of Automotive Engineers of Japan, Vol. 52, pp. 955–960, 2021. (DOI: <https://doi.org/10.11351/jsaeronbun.52.955>)
- 4) Iku SAITO, Shinya SATO, Hiroshi NOMURA, Yusuke SUGANUMA, Haruka MISAKA, Improvement of HC-SCR Performance by Fuel Reforming Using a Low Temperature Oxidation, SAE Technical Paper, Vol. 2021-01-0591, 2021. (DOI: 10.4271/2021-01-0591)
- 5) Iku SAITO, Hiroshi NOMURA, Yusuke SUGANUMA, Ichiro TSUMAGARI, Development of light-oil burner for heating exhaust gas of diesel engine, Transactions of the JSME (in Japanese), Vol. 82, 2016. (DOI: <https://doi.org/10.1299/transjsme.16-00014>)



Fuel Reformer and Catalyst Test Bench



Operating Range for Low-Temperature Oxidation Reactions (Simulation)

Effect of products of low temperature oxidation reaction on NO_x reduction in HC-SCR system

Iku SAITO, Hodaka SANO, Hiroshi NOMURA and Yusuke SUGANUMA

Hydrocarbon-selective catalytic reduction (HC-SCR) systems that do not require urea offer high convenience; however, they generally exhibit lower NO_x reduction performance compared to urea-SCR systems. Therefore, in this study, we aimed to enhance the NO_x reduction performance by generating NO_x reductants through fuel reforming via low-temperature oxidation reactions. The low-temperature oxidation of hydrocarbons is expected to produce oxygenated compounds such as aldehydes, which possess high NO_x reduction capabilities. To efficiently induce low-temperature oxidation reactions, a pre-evaporative and pre-mixing type fuel reformer capable of generating a homogeneous fuel/air premixed gas was developed. To prevent the transition to high-temperature oxidation reactions, the reforming chamber of the fuel reformer was designed with a high surface area-to-volume ratio, and its temperature was precisely controlled. As a fundamental investigation, NO_x reduction experiments and elementary reaction calculations were conducted to identify the reaction products, and the optimal reformer temperature and reforming equivalence ratio for promoting NO_x reduction on the catalyst surface were examined. As a result, the reformed fuel gas demonstrated a higher NO_x reduction performance in the catalyst temperature range of 473–773 K compared to unreacted fuel vapor. The highest NO_x reduction performance was observed when the reforming temperature was 673 K. Furthermore, at a catalyst temperature of 723 K, the NO_x conversion efficiency improved with an increase in the reforming equivalence ratio. These findings suggest that alcohols mainly contribute to NO_x reduction reactions at lower catalyst temperatures, while aldehydes play a dominant role at higher catalyst temperatures.

Keywords: HC-SCR, fuel reforming, low-temperature oxidation reaction, diesel after-treatment system

低温酸化反応生成物が HC-SCR システムにおける NO_x 浄化に及ぼす影響

尿素を必要としない HC-SCR システムは利便性が高い一方、例えば尿素 SCR と比較すると NO_x 浄化性能に劣る。そのため本研究では、NO_x 浄化性能を向上させるために、低温酸化反応を用いて燃料を改質し、NO_x 還元剤を生成することを試みた。炭化水素の低温酸化反応により、アルデヒドなどの NO_x 浄化性能の高い含酸素化合物の生成が期待される。低温酸化反応を効率的に起こすべく、均一な燃料/空気予混合ガスを生成できる、予蒸発・予混合式の燃料改質器を開発した。高温酸化反応への移行を防ぐため、燃料改質器の反応室は高い表面積/体積比を持つ構造とし、反応器温度を精密に制御した。基礎的な研究として、NO_x 浄化実験および素反応計算による反応生成物の特定を行い、触媒表面での NO_x 浄化を促進するために適した燃料改質器の温度および改質当量比を検討した。その結果、改質燃料ガスは、未反応の燃料蒸気と比較して、触媒温度が 473 ~ 773 K において高い NO_x 浄化性能を示した。NO_x 浄化性能が最も高くなったのは、改質温度が 673 K のときであった。また、触媒温度 723 K においては、改質当量比の増加に伴って NO_x 低減効率が向上した。

これらの結果から、低触媒温度域ではアルコール類が、高触媒温度域ではアルデヒド類が NO_x 浄化反応に主に寄与していることが示唆された。

キーワード：HC-SCR, 燃料改質, 低温酸化反応, ディーゼル排出ガス後処理技術

Journal (掲載誌)

Proceedings of the Combustion Institute, Vol. 39, pp. 4881–4888, 2023. (DOI: 10.1016/j.proci.2022.07.250)

Mika KATO

Professor, Department of Conceptual Design



Mika Kato received her Bachelor's degree in Architecture from the College of Science and Technology, Nihon University in 1999, followed by a Master's degree in 2001 and a DEng degree in 2004 from the same university. She served as a Research Assistant at Nihon University for one year and subsequently as a Postdoctoral Fellow from 2005 to 2009. She later held research appointments at Kansai University (2009–2010) and the Building Research Institute (2010–2011), engaged at both institutions concurrently during 2010. In 2013, she joined the Kanazawa Institute of Technology as a lecturer at the Department of Architecture, Faculty of Environmental and Architectural Design, and she was promoted to Associate Professor in 2017. Since 2018, she has been a faculty member of Nihon University's College of Industrial Technology, where she currently serves as a Professor at the Department of Conceptual Design. Dr. Kato's research field is architectural environmental engineering, focusing on the visual environment, lighting and color design, and environmental psychology. She explores how light and color influence spatial perception, comfort, and communication in architectural spaces. Her major research topics include:

- Mechanisms underlying the perception of spatial brightness in architectural interiors
- Light conditions that evoke a sense of softness and comfort
- Development of daylight control systems tailored to spatial functions
- Design of adaptive lighting systems that integrate daylight and artificial light through window luminance feedback
- Guidelines for effective color usage in environmental and signage design
- Methods for controlling excessive brightness in outdoor advertisements

Through these studies, Dr. Kato contributes to standardization and design guidelines as an active member of the Architectural Institute of Japan (AIJ), the Illuminating Engineering Institute of Japan (IEIJ), and the Japanese National Committee of the CIE (Commission Internationale de l'Éclairage). She is also engaged in educational and outreach activities, including organizing symposia for lighting professionals and hands-on learning programs for students.

Research Achievements

- 1) Consideration of Luminance Standard Values Based on Appropriate Contrasts Between Desk Illuminance and the Average Luminance of the Space, 2024 IEEE Sustainable Smart Lighting World Conference & Expo (LS24), 2024. (DOI: 10.1109/LS2463127.2024.10881907)
- 2) Study on the Relationship Between Window Specifications and Occupants' Assessment of Light and Visual Environment in Japanese Housing, 2024 IEEE Sustainable Smart Lighting World Conference & Expo (LS24), 2024. (DOI: 10.1109/LS2463127.2024.10881228)
- 3) Evaluation Structure of Visual Environment in Residential Spaces with Windows, Transactions of AIJ: Journal of Environmental Engineering, Vol. 89, pp. 193–201, 2024. (DOI: 10.3130/aije.89.193)
- 4) Influence of Interior Reflectance and Correlated Color Temperature on the Perceived and Required Levels of Spatial Brightness for Various Activities, Transactions of AIJ: Journal of Environmental Engineering, Vol. 87, pp. 411–416, 2022. (DOI: 10.3130/aije.87.411)
- 5) Survey of Luminance of Outdoor Digital Signage at Night, Journal of the Illuminating Engineering Institute of Japan, Vol. 106, Issue R1, pp. 36–42, 2022. (DOI: 10.2150/jieij.21000614)

Investigation of the Balance Between Work Surface Illuminance and Spatial Average Luminance in Desk Workspaces: A Comparison of Younger and Older Adults

Mika KATO

This paper examines how visual-task illuminance on the desk should be balanced with the spatial average luminance of the surrounding field in office-like environments. It starts from a standards context in which ceiling and wall targets, when derived from low assumed reflectance, can create excessive contrast between a bright work plane and a comparatively dim room, potentially degrading visual comfort and readability. To address this, controlled experiments with varied combinations of work-surface illuminance and room average luminance across a matrix of conditions collected judgments on spatial brightness, desk brightness, balance between the two, spatial comfort, preference for light-dark contrast, concentration, text readability, eye fatigue, acceptability of contrast, and a Landolt-ring acuity test. The findings converge on a practical constraint: when the ratio of the desk illuminance to spatial average luminance exceeds roughly 20:1, the share of evaluations labeling the balance “inappropriate” rises to around half the observers. Sensitivity is not uniform across the conditions: readability responds strongly to increased illuminance for older viewers, whereas younger viewers penalize excessive contrast more than absolute illuminance, implying different limiting mechanisms. These patterns suggest that prescribing only the minima for individual metrics is insufficient; explicit contrast management is needed to sustain comfort and performance across diverse users. Design implications follow directly. In open-plan offices, globally raising the general illuminance to satisfy the most sensitive viewers is energy-inefficient. More effective is zoned lighting and task lighting supplementation that raises local illuminance where needed while keeping the illuminance-to-luminance ratio within an envelope near the 20:1 threshold. Framed this way, illuminance and luminance are not independent dials but a linked pair that should be tuned jointly. The evidence is positioned to inform revisions to luminance-based guidance so that numeric targets better align with actual perceptual outcomes in contemporary workplaces.

Keywords: Luminance standard, work surface illuminance, spatial average luminance, visual comfort, spatial brightness, age group comparison

机上面照度と空間平均輝度のバランスが視的快適性に与える影響 — 若年層と高齢層の比較 —

本論文は、オフィス相当空間における机上面照度と空間平均輝度の適切なバランスを検討するものである。天井・壁の基準を低い反射率を前提に設定すると、机上面だけが明るく周囲が相対的に暗く、いわゆる過大なコントラストが生じ、視的快適性や可読性を損なうおそれがある。そこで両指標の組合せを系統的に変化させ、空間の明るさ、机上面の明るさ、両者のバランス、空間快適性、明暗コントラスト嗜好、集中のしやすさ、文字の読みやすさ、眼精疲労、コントラスト許容度、視力（ランドルト環）を評価した。

結果として、照度／輝度比が概ね 20:1 を超えると、バランスを「不適切」と判断する割合が約半数に達する傾向が確認された。さらに、可読性は高齢者では照度の増加に強く反応する一方、若年者では絶対照度よりも過大なコントラストの影響が大きいなど、支配的な制約条件が年齢層で異なることが示唆された。これらの所見は、照度や輝度において、個別指標の最小値の提示だけでは不十分であり、対比（コントラスト）の明示的管理が不可欠であることを示す。

設計的含意として、オープンプランオフィスで全体照度を一律に引き上げる方法は省エネルギーの観点から望ましくない。ゾーニングやタスク照明を用いて必要部位のみ局所的に照度を補い、机上面照度／空間平均輝度比を 20:1 程度に保つ戦略が有効である。机上面照度と空間平均輝度を相互に連成した設計変数として同時に最適化する視点は、現行の輝度基準の見直しに資する根拠となる。

キーワード：輝度基準，机上面照度，空間平均輝度，視的快適性，空間の明るさ，年齢層比較

Proceedings（会議録）

Proceedings of the CIE 2025 Scientific Conference (Proceedings of the CIE). Vienna, Austria: International Commission on Illumination (DOI:10.25039/x051.2025).

Hodaka YAMAGUCHI

Assistant Professor, Department of Conceptual Design



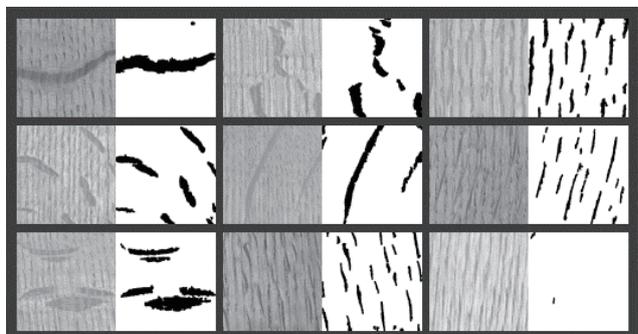
Hodaka Yamaguchi is an Assistant Professor at the Department of Conceptual Design, College of Industrial Technology, Nihon University. He received his PhD in Engineering from Shinshu University in 2015. From 2015 to 2025, Dr. Yamaguchi was a researcher at the Gifu Prefectural Research Institute for Human Life Technology. His primary research was on the intersection of wooden products and Kansei engineering, which included studies on the impression evaluation and image analysis of wood grain patterns, furniture design and strength testing, and 3D scanning and visualization of wooden products. Having joined Nihon University in 2025, he is now expanding his research to include the active use of the unique characteristics of individual pieces of wood in design. His goal is to increase the added value of wood and contribute to sustainable wood and forestry industries. Dr. Yamaguchi is a member of the Japan Society of Kansei Engineering (JSKE), the Japan Wood Research Society (JWRS), and the Japan Human Factors and Ergonomics Society (JES).

Research Achievements

- 1) Hodaka YAMAGUCHI, Goroh FUJIMAKI, Tomohiko MORIMO, Masashi NAKAMURA, Analysis of Preferences for Wooden Panels with Different Visual Homogeneities, *International Journal of Affective Engineering*, Vol. 22(1), pp. 25–33, 2023.
- 2) Hodaka YAMAGUCHI, Goroh FUJIMAKI, Naruto MIYAGAWA, Hiroaki YOSHIDA, Design of Flat/Sloped Writing Desk Considering Acceptability of Individual Preference Regarding Desk Heights, *International Journal of Affective Engineering*, Vol. 20(4), pp. 209–215, 2021.
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Variations in Wood Grain Pattern Matching



Extraction of Broad Ray Patterns via Image Analysis

Analysis of Preferences for Wooden Panels with Different Visual Homogeneities - Examination by Implementation of Individual Classification according to Evaluation Tendency -

Hodaka YAMAGUCHI, Goroh FUJIMAKI, Tomohiko MORIMO, and Masashi NAKAMURA

Wooden panels that are made of glueing elements with various appearances, involve numerous visual combinations. Although craftspeople believe that homogeneous patterns are desirable, it is helpful to clarify the acceptability of heterogeneous patterns from the perspective of sustainability. This study classified individuals based on their evaluation tendencies and examined their preferences. We performed a subjective evaluation of 17 sample images of 109 participants using an online survey. Consequently, it was found that patterns evaluated as “even” are generally more preferred. However, the classified clusters showed differences in their evaluation tendencies. For instance, the general consumer group confirmed only “heterogeneity” and the expert group felt “naturalness” from all samples. Additionally, there was a cluster that might have derived additional value from more homogeneous patterns. We conclude that an even appearance is desired, and additional information illustrating the characters of the wooden panel is needed to release unique patterns.

Keywords: Wooden furniture, Online survey, Cluster analysis

見た目の均質さが異なる木製天板に対する好みの分析 — 評価傾向に基づいた個人分類による考察 —

個々に見た目が異なる木材を接着して作られる木製天板の模様には無数の組み合わせが存在する。従来、木工職人は均質な見た目の組み合わせが好ましいと考えてきたが、持続可能性の観点からは不均質な見た目の天板が市場に受け入れられる可能性を明らかにすることが有意である。本研究では、個人を評価傾向に基づいて分類し、それぞれの嗜好を考察した。実験では、オンライン調査を用いて109名の参加者に17点のサンプル画像に対する主観的評価を実施した。その結果、大局的には「均質」と評価されるパターンが好まれる傾向が確認された。一方で、分類されたクラスター間では評価傾向に差異が見られた。例えば一般消費者と考えられるグループは「不均質性」のみを確認し、専門家と考えられるグループは全サンプルから「自然さ」を感じていた。さらに、より均質なパターンに付加価値を見出す可能性のあるクラスターも存在した。以上より、大局的には均質な見た目の幅はぎパネルの方が好まれやすいと結論づけられ、不均質な見た目の幅はぎパネルを活かすためには、その特性を示す追加情報が必要であることが示唆された。

キーワード：木製家具，オンライン調査，クラスター分析

Journal (掲載誌)

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Research Achievements

- 1) Conversion Experience as a Source of Poetic Imagination: A Study of Jones Very's Poems and Ideas, *Soundings* (50), 83-97, December 2024
- 2) Revisiting Edward Taylor's Early Poems: A Study of His "My last Declamation," *Soundings* (48), 121-137, October 2022
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Conversion Experience as a Source of Poetic Imagination: A Study of Jones Very's Poems and Ideas

Yuta MINAGAWA

Jones Very (1813–1880), once admired by Transcendentalists and Unitarian thinkers, has largely receded from contemporary American literary scholarship. While his so-called “ecstatic period” (1838–1840), characterized by a radical shift in spiritual consciousness and prolific poetic output, is frequently emphasized, focusing exclusively on this phase can obscure the complexity of his literary and religious vision. Although recent biographies and dissertations offer valuable insights, Very’s broader body of work—including poems engaging with social issues such as war and scientific advancement—remains underexplored. This study investigates the relationship between Very’s spiritual transformation and the images and imagery found in both his prose and poetry. It traces the influence of his conversion experience across his poetic career in order to provide a more expansive understanding of Very as both a mystic and a socially engaged thinker. In his letter to Henry W. Bellows and the “Epistles,” Very articulates theological ideas centered on rebirth, peace, and divine will— themes that consistently appear in his poetry. His concept of peace, often portrayed as a spiritual condition in which inner spiritual conflict is resolved, carries eschatological significance and reflects insights gained during his conversion. In addition, the imagery of universal kinship and the shared origin of all existence highlight his enduring spiritual worldview grounded in his religious experience. These motifs appear not only in meditative poems from his ecstatic period but also in later works that grapple with pressing societal concerns. That Very employed these spiritual motifs throughout his body of work suggests that his poetry is not merely the product of a fleeting mystical experience, but rather the expression of a profound religious and sociological consciousness. His verse stands at the intersection of inner revelation and social reality, demonstrating how personal spiritual insight can evolve into a broader engagement with public and ethical concerns.

「詩的想像力の源泉としての回心体験——ジョーンズ・ヴェリーの詩と思想の一考察」

ジョーンズ・ヴェリー (Jones Very, 1813–1880) は、かつて超絶主義者やユニテリアンの思想家たちから高く評価されていたが、現代のアメリカ文学研究においてはほとんど顧みられなくなっている。確かに、彼が経験したいわゆる「忘我状態の時期」(1838–1840)は、強い信仰心と旺盛な詩作によって特徴づけられるため、注目されることが多い。しかし、この時期のみに焦点を当てることは、彼の詩と思想の解釈を単純化してしまうことにつながりかねない。事実、戦争や科学の発展といった社会的テーマを扱った詩を含む、ヴェリーのより広範な作品群は依然として十分に検討されていない。本研究は、ヴェリーの霊的体験と彼の散文や詩に見られるイメージや象徴表現との関係を考察するものであり、彼の回心体験が詩作品全体にどのような影響を与えたかを明らかにし、神秘主義者であると同時に社会的関心を持つ思想家としてのヴェリー像に迫った。

ヘンリー・W・ペロウズ宛の書簡や“Epistles”において、ヴェリーは新生、平和、神の意志を中心とした神学的思想を展開している。これらの主題は彼の詩作品にも繰り返し登場する。例えば、彼が描く「平和」は、信仰を巡る内面的葛藤が解消される霊的な状態として表現され、終末論的な意味を帯びており、回心によって得られた洞察が反映されている。また、「普遍的親類関係」や「すべての存在の共通の起源」といったテーマは、彼の宗教経験に根ざした霊的世界観を浮かび上がらせる。この世界観は一貫して彼の作品に現れる。すなわち「忘我状態の時期」に書かれた瞑想的な詩だけでなく、社会的課題に取り組む作品にも見られるのである。こうした霊的モチーフが継続して用いられることは、ヴェリーの詩作品が一時的な神秘体験の産物ではなく、深い宗教的および社会的認識に基づく思想的営為の賜物であることを示している。また彼の詩は、内面的な啓示と社会的現実との交差点に立ち、個人の霊的探求が公共的な問いへと展開しうる可能性を暗示しているのである。

Journal (掲載誌)

Soundings Vol. 50, 83-97, December 2024

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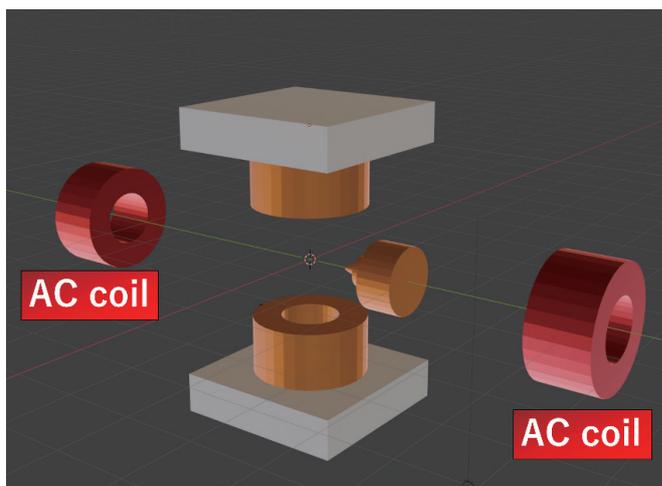


Fig. 1 Quantum Turbulence Generation Project Using AC Coils

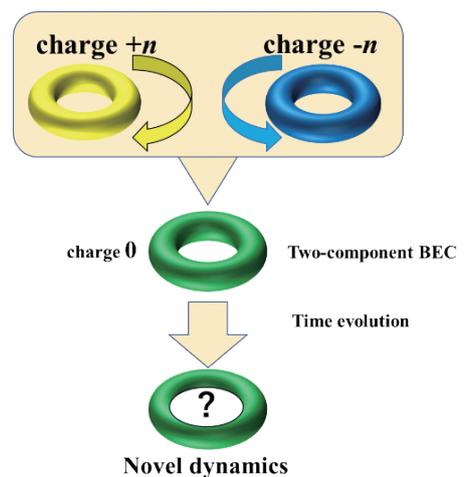


Fig. 2 Counter-Superfluidity Project

Transfer of Bose–Einstein Condensates from Quadrupole-Ioffe-configuration Magnetic Trap to Crossed-beam Optical Trap

Takeshi KUWAMOTO and Hitoshi SHIBAYAMA

In this study, we generated a Bose–Einstein condensate (BEC) of 87 rubidium atoms in a QUIC magnetic trap and captured it in a cross optical trap formed by a 1064 nm YVO₄ laser. When the BEC was released from the QUIC magnetic trap, it was unable to transfer to the cross optical trap due to the influence of a transient magnetic field (eddy current). To solve this problem, we applied a pulsed magnetic field to cancel the transient magnetic field when the QUIC magnetic trap current was turned off. By applying this magnetic field, we achieved a stable transfer of the BEC to the cross optical trap. The BEC transfer efficiency was 70%, and the 1/e lifetime of the BEC in this cross optical trap was approximately 3 s. This result enables advanced research in spinor BECs, taking advantage of the spin degree of freedom, which is not possible with magnetic traps. We will apply these results to investigate the physical properties of superfluid. We have launched two advanced research projects. Figure 1 shows the project to create quantum turbulence in a BEC by applying an AC magnetic field. After the quantum turbulence formation, we can transfer it to an optical trap, providing a new quantum fluid state, where we can observe spin–spin interactions in the turbulent state and turbulence dynamics due to differences in the potential shapes. Furthermore, we believe that by forming quantum vortices in a two-component BEC using a topological method, as shown in Figure 2, we can construct a new physical system called counter-superfluidity.

Keywords: Bose–Einstein condensates, BEC, atomic spin, optical trap, QUIC magnetic trap

QUIC 磁気トラップ中 BEC のクロス光トラップへの移行

本論文は、87 ルビジウム原子のボース・アインシュタイン凝縮体（以下：BEC と略す）を QUIC 磁気トラップ中で生成し、波長 1064 nm の YVO₄ レーザーで形成したクロス光トラップに捕獲する。QUIC 磁気トラップから BEC を解放すると、過渡的な磁場（渦電流）の影響でクロス光トラップへの移行を行うことが出来なかった。この問題を解決するため、QUIC 磁気トラップ電流を切るタイミングで過渡的な磁場を打ち消すパルス磁場を印加した。この磁場を印加することによって BEC のクロス光トラップへの安定移行を実現した。BEC の移行効率は 70% であり、このクロス光トラップ中での BEC の 1/e 寿命は約 3 s であった。この成果によって磁気トラップではできない、スピン自由度を活かしたスピノール BEC 中での発展研究が可能となる。この成果を応用し、超流動体の物性研究を行っていく。2つの発展研究プロジェクトを立ち上げた。Fig 1 は、AC 磁場を印加して BEC 中に量子乱流を形成するプロジェクトである。量子乱流形成後、光トラップに移行することで、乱流状態でのスピン・スピン相互作用やポテンシャル形状の違いによる乱流ダイナミクスの観測という新たな量子流体の状態を提供できる。また、Fig 2 のように 2 成分 BEC 中での位相幾何学的方法による量子渦形成を行うことによって、対抗超流動という新たな物理系を構築できると考える。

キーワード：ボース・アインシュタイン凝縮体、BEC、原子スピン、光トラップ、QUIC 磁気トラップ

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