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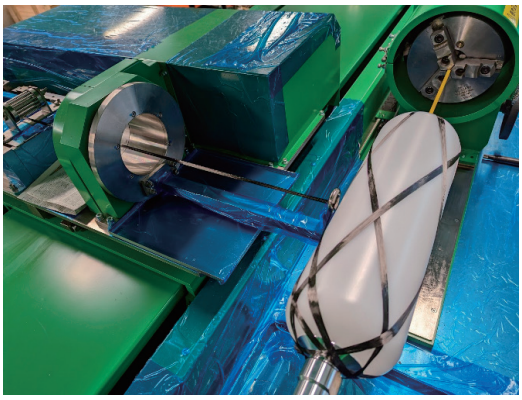
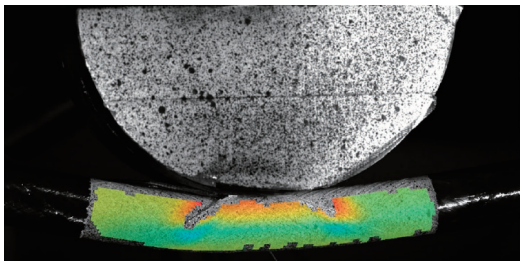
Kazuhiro Sakata is a Professor at the Department of Mechanical Engineering, College of Industrial Technology, Nihon University. He received his BScEng in 2003 and MScEng in 2005. From 2005 to 2007, he worked in the FCV (Fuel Cell Vehicle) Engineering Department at Nissan Motor Co., Ltd. and from 2008 to August 2009, he worked in the Fuel Cell Laboratory at the Nissan Research Center. In September 2009, he joined Nihon University as a Research Associate. He received his EngD degree at Nihon University in 2013 with his thesis "Study on Increase of Burst Pressure of CFRP Pressure Vessels and Their Optimum Structural Design." Since 2024, he has served as a Professor at Nihon University. Dr. Sakata is a member of the Japan Society of Mechanical Engineers, the Japan Society for Composite Materials, the Japan Reinforced Plastics Society, the Society of Automotive Engineers of Japan, and the Japan Society for Design Engineering. His research interests include advanced composites manufacturing and processing, carbon and glass composites, and thermoplastic composites.

Research Achievements

1) Fabrication and impact properties of FW-CFRP cylinders using large tow carbon fibers, Reinforced Plastics, Volume 70, Issue 3, 88-89, 2024.
2) VaRTM process of GFRTP using in situ polymerizable thermoplastic urethane resin, Reinforced Plastics, Volume 69, Issue 12, 513-518, 2023.
3) Tensile, compressive, and fatigue strength of a quasi-isotropic carbon fiber reinforced plastic laminate with a punched hole, Heliyon, Volume 6, Issue 12, e05690, DOI : 10.1016/j.heliyon.2020.e05690, 2020.
4) Development of fast fabrication method for cylindrical-shaped grids and mechanical properties of CFRP pressure vessel reinforced with cylindrical-shaped grids, Advanced Composite Materials,Volume 25, No.S1, 1-16, 2016.
5) Evaluation of new GFRTP and CFRTP using epsilon caprolactam as matrix fabricated with VaRTM, Science and engineering of composite materials, Volume 22, Issue 6, 633-641, 2015.



FW (Filament winding) of CFRP pressure vessel



DIC (Digital Image Correlation) of FRTP cylinder subjected to impact loading

Published Paper

Optimum structural design of CFRP isogrid cylindrical shell using genetic algorithm

Kazuhiro Sakata, Takashi Suzuki and Goichi Ben

Carbon fiber reinforced polymer (CFRP) isogrid cylindrical shells are composed of a thin surface skin with repetitive equilateral triangular grid stiffeners. They are mainly used for aerospace applications due to their high strength, stiffness, and light weight.

In this study, we used a response surface constructed by design space partitioning and a genetic algorithm for the optimum structural design of a CFRP cylindrical shell. We obtained the shape that minimizes the weight of the CFRP isogrid cylindrical shell under the constraint conditions of no buckling or material failure when subjected to the prescribed uniaxial compressive load. Moreover, we demonstrated that the buckling and material failure loads of the CFRP cylindrical shell can be determined quickly and accurately using this method.

Keywords: CFRP isogrid cylindrical shell, optimum structural design, genetic algorithm

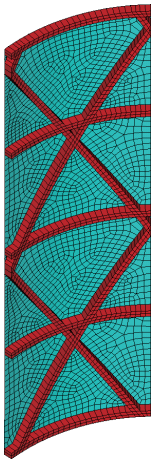
遺伝的アルゴリズムによるCFRPアイソグリッド円筒殻の最適構造設計

CFRP アイソグリッド円筒殻は，薄い表面スキンと正三角形のグリッド補強材で構成されており，強度と剛性が高く，軽量であることから，主に航空宇宙用途で使用されています。

本研究では，CFRP アイソグリッド円筒殻の最適構造設計に設計空間分割最小二乗法により構築した応答曲面と遺伝的アルゴリズムを使用し，CFRP アイソグリッド円筒殻に既定の軸圧縮荷重を設けた際に座屈と材料破損が生じない制約条件の下で，CFRP アイソグリッド円筒殻の重量が最小となる形状を求めました。そして，本手法を用いることでCFRP 円筒殻の座屈および材料破損荷重を短時間かつ正確に求めることができることを示しました。

キーワード：CFRPアイソグリッド円筒殻，最適構造設計，遺伝的アルゴリズム

CFRP isogrid cylindrical shell



FEM model (Cyclic symmetry model) of CFRP isogrid cylindrical shell

Journal（掲載誌）
Advanced Composite Materials, Volume 27, No.1, 35-51, 2018.

Yusuke SUGANUMA

Associate Professor, Department of Mechanical Engineering

Yusuke Suganuma is an Associate Professor at the Department of Mechanical Engineering, College of Industrial Technology, Nihon University. After receiving his master's degree at the Graduate School of Nihon University in 2007, he worked at IHI Aerospace on the structural design of solid rockets and the production technology of FRP parts. Dr. Suganuma started his research career at the College of Industrial Technology, Nihon University in 2014. He received his doctoral degree from Nihon University in 2018. The title of his doctoral thesis was "Experimental study on flame spread along a droplet array as a simplified model of fuel spray." His research includes fuel droplet combustion to elucidate the group combustion mechanism of spray combustion. Since this research must be conducted in a microgravity environment, his experiments are carried out using a drop tower, an aircraft, a small rocket, and the ISS (International Space Station). He also works towards improving internal combustion engine combustion, mainly conducting experiments on improving ignition plugs. He is a member of the Japan Society of Microgravity Application (JASMA), the Combustion Institute of Japan, the Japan Society of Mechanical Engineers (JSME), the Japan Society for Aeronautical and Space Sciences (JSASS), the Japan Society of Automotive Engineers (JSAE), and the Institute for Liquid Atomization and Spray Systems (ILASS-Japan).

Research Achievements

1) Development of Forced Cool-Flame Ignition and Detection Device for a Fuel Droplet, International Journal of Microgravity Science Application., 39 (3) 390303, 2022, 10.15011/jasma.39.390303

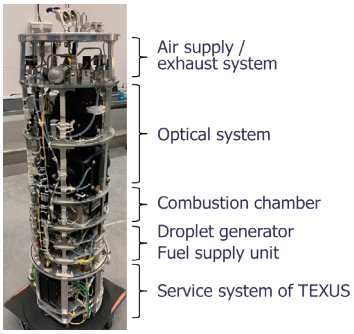
2) Experimental Study on Unsteadiness of n-decane Single Droplet Evaporation and Effect of Natural Convection on Droplet Evaporation at High Pressures and Temperatures, Transactions of the Japan Society for Aeronautical and Space Sciences, 19 (5) 647-653, 2021, 10.2322/tastj.19.647

3) Scope of PHOENIX-2 Sounding Rocket Experiment, "Cool Flame Dynamics in Multi-droplet Ignition," International Journal of Microgravity Science Application., 37 (4) 370401, 2020, 10.15011/jasma.37.4.370401

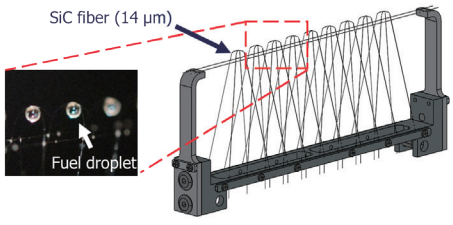
4) Generation of a Large-Scale n-Decane-Droplet Cloud Considering Droplet Pre-Vaporization in "Group Combustion" Experiments aboard Kibo/ISS, International Journal of Microgravity Science Application,35 (2) 350202, 2018, 10.15011//jasma.35.350202

5) Droplet Array Combustion Experiments on Effect of Initial Droplet Diameter on Flame Spread Characteristic Time, Transactions of the Japan Society for Aeronautical and Space Sciences, 60 (3) 127-131, 2017, 10.2322/tjsass.60.127

Drop tower of microgravity experiments (in our campus).



Droplet combustion experimental apparatus for sounding rocket experiments



Droplet array suspension system

Published Paper

Droplet Array Combustion Experiments on Effect of Initial Droplet Diameter on Flame Spread Characteristic Time

Yusuke SUGANUMA, Noriyuki IKEYAMA, Hiroshi NOMURA, and Yasushige UJIIE

This experimental study focuses on spray combustion, which is often used in internal combustion engine combustors, and attempts to clarify the group combustion mechanism. The power source for transportation vehicles such as cars is being replaced by electric power, but many devices still require internal combustion engines that use liquid fuels from the perspective of energy density. Liquid fuels can be produced by chemical synthesis, and the development of carbon-neutral synthetic fuels such as SAF and e-fuel is underway. Although the problem of production cost needs to be solved for synthetic fuels, they have an advantage in that existing fuel transportation methods can be used as is, and internal combustion engines can be used as is without major changes. It is expected that internal combustion engines will continue to be used in the future, and so environmental adaptation of internal combustion engines is an urgent task.

The combustion phenomena of liquid fuels are very complex and are not fully elucidated even today. This is because the gas–liquid phase changes, spatial nonuniformity, and chemical reactions affect each other. In this study, we conducted a combustion experiment with a fuel droplet array under a microgravity environment to investigate the fuel droplet combustion mechanism. The purpose of this study was to understand the dependence of the flame propagation speed on the droplet spacing and initial droplet diameter. A droplet array was used in the experiment with n-decane employed as the fuel. The initial fuel droplet diameter was 0.48 mm. Ten fuel droplets were lined up in a row and ignited at one end. A high-speed video camera captured the flame spreading along the droplet array. The flame spread behavior was observed in detail, and the relationship between the travel time of the flame spreading between the droplets, the characteristic time of the chemical reaction, and the physical characteristic time was clarified.

Keywords: spray combustion, initial droplet diameter, fuel droplet array, flame spread speed, microgravity

燃料液滴列燃焼における初期液滴直径が火炎燃え広がり特性時間に及ぼす影響

本研究は，内燃機関の燃焼器に多く採用されている噴霧燃焼に着目し，群燃焼メカニズムを解明しようとする実験的研究である。車をはじめとした輸送機の動力源は電動化への置き換えが進められているが，エネルギ密度の観点から，液体燃料を使用する内燃機関を必要とする機器も多い。液体燃料は化学合成で製造することができ，SAFやe-fuelといったカーボンニュートラルな合成燃料の開発が進められている。合成燃料は製造コストの問題を解決する必要があるが，既存の燃料の輸送方式をそのまま使用することができ，内燃機関も大きな変更なくそのまま使用することができるというメリットがある。内燃機関は今後も使用されることが期待され，その場合，内燃機関の環境適合は急務である。

液体燃料の燃焼現象は非常に複雑であり，現代においても完全には解明されていない。これは，燃料の相変化，空間の不均一性，化学反応が相互に影響を及ぼし合うためである。本紙では，燃料液滴燃焼メカニズムを明らかにするため，微小重力環下で燃料液滴列の燃焼実験を行った。本研究の目的は火炎伝播速度が液滴間隔と初期液滴直径の依存性を理解することである。実験モデルは燃料液滴列である。燃料の初期液滴直径は0.48mmである．10個の燃料液滴を1列に並べ，液滴列の片端より強制点火させた。液滴列に沿って火炎の燃え広がる様子を高速度ビデオカメラによって撮影した。燃え広がり挙動を詳細観察し，液滴間を燃え広がる火炎の移動時間と化学反応の特性時間と物理的な特性時間の関係について明らかにした。

キーワード：噴霧燃焼，初期液滴直径，液滴列，火炎燃え広がり速度，微小重力

Journal（掲載誌）
Transactions of the Japan Society for Aeronautical and Space Sciences, 60 (3) 127-131, 2017，10.2322/tjsass.60.127

Kazumasa IIDA

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Kazumasa Iida is a Professor at the Department of Electrical and Electronic Engineering, College of Industrial Technology, Nihon University. He received his PhD in Engineering from Nagoya University in 2003, after which he pursued postdoctoral research at the University of Cambridge under the distinguished mentorship of Professor David A. Cardwell. After spending three and a half years in Cambridge, he was invited as a senior scientist by Professors Ludwig Schultz and Bernhard Holzapfel to join the Leibniz Institute for Solid State and Materials Research in Dresden, Germany. In 2014, he was appointed as an Associate Professor at Nagoya University. In 2022, he joined Nihon University as a Full Professor. His research experience spans a wide range of materials, including the fabrication of Sr–ferrite magnets, the growth of garnet films for magneto-optical imaging, and the growth of cuprates and Fe-based superconducting materials in the form of bulk and thin films. He has published more than 220 peer-reviewed research papers, with an h-index of 39. He has given more than 60 invited talks and plenary lectures at international conferences. He is currently on the editorial board of the journal *Superconductivity* (Elsevier).

Research Achievements

1) Quadrupling the depairing current density in the iron-based superconductor $SmFeAsO_{1-x}H_x$, *Nature Materials* **23**, 1370-1378 (2024). https://doi.org/10.1038/s41563-024-01952-7

2) High tolerance of the superconducting current to large grain boundary angles in potassium-doped $BaFe_2As_2$, *NPG Asia Materials* **16**, 41 (2024). https://doi.org/10.1038/s41427-024-00561-9

3) Structural analysis and transport properties of [010]-tilt grain boundaries in Fe(Se,Te), *Science and Technology of Advanced Materials* **25**, 9 (2024). https://doi.org/10.1080/14686996.2024.2384829

4) Recent progress on epitaxial growth of Fe-based superconducting thin films, *Superconductor Science and Technology* **36**, 063001 (2023). https://doi.org/10.1088/1361-6668/acccb2

5) Inter- to intra-layer resistivity anisotropy of NdFeAs(O,H) with various hydrogen concentrations, *Physical Review Materials* **6**, 054802 (2022). https://doi.org/10.1103/PhysRevMaterials.6.054802

Published Paper

Quadrupling the depairing current density in the iron-based superconductor $SmFeAsO_{1-x}H_x$

M. Miura, S. Eley, K. Iida, K. Hanzawa, J. Matsumoto, H. Hiramatsu, Y. Ogimoto, T. Suzuki, T. Kobayashi, T. Ozaki, H. Kurokawa, N. Sekiya, R. Yoshida, T. Kato, T. Okasa, H. Okazaki, T. Yamaki, J. Hänisch, S. Awaji, A. Maeda, B. Maiorov, H. Hosono

Iron-based 1111-type superconductors exhibit high critical temperatures (T_c) and relatively high critical current densities (J_c), crucial for practical superconducting applications. A typical strategy for enhancing J_c is introducing defects to control vortex motion, which helps prevent energy dissipation. However, even when optimized, this approach is limited to achieving a maximum J_c of around 30% of the depairing current density (J_d), the theoretical upper limit of the current that a superconductor can carry without losing its superconducting properties. This limit is determined by fundamental parameters, such as the coherence length and penetration depth. In this study, we dramatically increased J_c in $SmFeAsO_{1-x}H_x$ films by targeting the enhancement of J_d itself, alongside the introduction of vortex pinning centers. By increasing the carrier density through high electron doping via hydrogen substitution, we reduced the penetration depth, coherence length, and anisotropy of the upper critical field, ultimately boosting J_d. Remarkably, this strategy quadrupled J_d, reaching 415 MA/cm^2, comparable to that of high T_c cuprates. To further optimize J_c, we introduced defects using proton irradiation, which effectively enhanced vortex pinning and allowed for high J_c values in magnetic fields up to 25 T. By applying this method to other iron-based superconductors, we achieved a similar enhancement in current densities, demonstrating the broad applicability of our approach. The dual strategy of boosting J_d and optimizing vortex pinning pushes the limits of J_c and significantly enhances the performance of iron-based superconductors. These advancements hold great potential for high-field applications, including powerful magnets, superconducting cables, and energy storage systems, contributing to the development of efficient superconducting technologies.

Keywords : Fe-based superconductors, depairing current density, topotactic reaction, thermodynamic approach, condensation energy

鉄系超伝導体 $SmFeAsO_{1-x}H_x$ における対破壊電流密度の 4 倍増加

鉄系1111型超伝導体は，高い臨界温度（T_c）と比較的高い臨界電流密度（J_c）を示し，実用的な超伝導応用において重要です．J_cを向上させる一般的な戦略は，欠陥を導入して量子化磁束の運動を制御し，エネルギー損失を防ぐことです．しかし，この方法を最適化しても，達成できるJ_cは対破壊電流密度（J_d）の約30%が限界です．J_dは，超伝導体が超伝導特性を失わずに運ぶことができる電流の理論的な上限であり，コヒーレンス長や磁場侵入長などの基本的なパラメータによって決定されます．本研究では，$SmFeAsO_{1-x}H_x$薄膜において，J_d自体の向上を目指し，量子化磁束のピン止め中心の導入とともにJ_cを劇的に増加させます．水素置換による高電子ドーピングによりキャリア密度を増加させることで，磁場侵入長，コヒーレンス長，および上部臨界磁場の異方性を減少させ，結果としてJ_dを増強しました．この戦略により，J_dは4倍に増加し，415 MA/cm^{2}に達し，高温超伝導体に匹敵する値となりました．さらにJ_cを最適化するため，プロトン照射を用いて欠陥を導入し，量子化磁束のピン止めを効果的に強化し，最大25 Tの磁場中で高いJ_cを実現しました．この方法を他の鉄系超伝導体に適用することで，同様のJ_cの向上が得られ，本手法の広範な適用可能性を示しました．J_dの向上と量子化磁束のピン止めの最適化という二重の戦略は，J_cの限界を押し上げ，鉄系超伝導体の性能を大幅に向上させます．これらの進展は，強力な磁石，超伝導ケーブル，エネルギー貯蔵システムなどの高磁場応用に大きな可能性を秘めており，効率的な超伝導技術の発展に貢献します．

キーワード：鉄系超伝導体，対破壊電流密度，トポタクティック反応，熱力学的アプローチ，凝縮エネルギー

Journal（掲載誌）
Nature Materials **23**, 1370–1378 (2024). https://doi.org/10.1038/s41563-024-01952-7

Makoto SASAKI

Associate Professor, Department of Electrical and Electronic Engineering

Makoto Sasaki is an Associate Professor at Nihon University. He received his Ph.D degree in science from the University of Tokyo in 2009, through theoretical research on plasma turbulence. From April to December 2009, he was engaged in the research at the Central Research Laboratory of NEC Corporation, studying the heat diffusion processes on the semiconductors. From 2010 to 2020, he served as an Assistant Professor at the Research Institute of Applied Mechanics, Kyushu University, and studied the nonlinear processes of turbulence in fusion plasma based on theories and simulations. He was also a visiting researcher at Aix-Marseille University, France, in 2018, and at Warwick University, United Kingdom, in 2019. He moved to the College of Industrial Technology, Nihon University in 2021. His research interests include statistical theory of turbulence, development of data-driven science methods, big-data analysis and machine learning. He is a member of the Physical Society of Japan (JPS) and the Japan Society of Plasma Science and Nuclear Fusion (JSPF).

Research Achievements

1) Evaluation of abrupt energy transfer among turbulent plasma structures using singular value decomposition, Plasma Physics and Controlled Fusion, 63, 025004-1, 025004-13 (2021).
2) Formation of density corrugations due to zonal flow in wave-kinetic framework, Physics of Plasmas, 28, 112304-1, 112304-7 (2021)
3) Spatiotemporal dynamics of high-wavenumber turbulence in a basic laboratory plasma, Scientific Reports, 12, 19799 (2022)
4) Estimation of 2D profile dynamics of electrostatic potential fluctuations using multi-scale deep learning, Plasma Phys. Control. Fusion 65, 125003 (2023).
5) Nonlinear simulation of resistive drift waves in cylindrical magnetized plasmas in the presence of symmetry breaking particle source, Physics of Plasmas, 30, 082302 (2023).

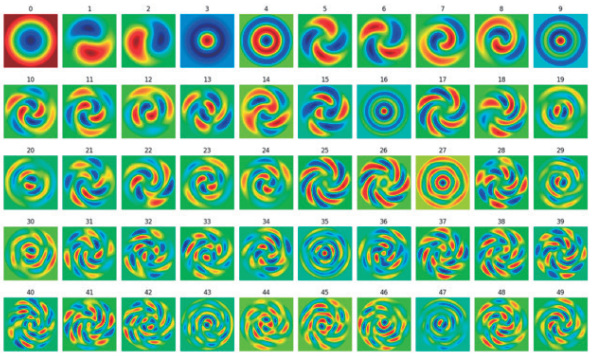

Fig. 1: Spatial patterns of plasma turbulence

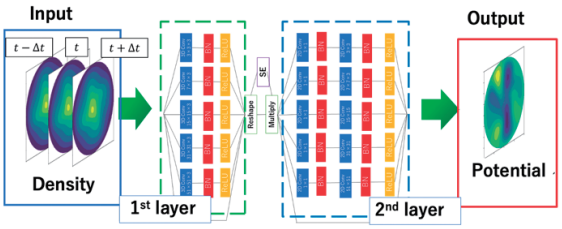

Fig. 2: Prediction of pattern based on eural Networks [4]

Published Paper

Nonlinear simulation of resistive drift waves in cylindrical magnetized plasmas in the presence of symmetry breaking particle source

M. Sasaki, N. Kasuya, Y. Kawachi, T. Kobayashi, T. Nishizawa, H. Arakawa, T. Yamada, A. Fujisawa

In fusion plasmas, external inputs of particles and heat are essential. The external source breaks the spatial symmetry of plasmas, which has been observed experimentally. However, it has not been considered in the research of turbulence transport. In this study, we introduce a stationary particle source that breaks the spatial symmetry of the plasma in a nonlinear turbulence simulation. Due to the particle source, the density increased to drive the turbulence called resistive drift wave, and the particle was transported by the turbulence. It has been pointed out that the large-scale vortex or flows are generated nonlinearly by the turbulence, which dominate the transport. Thus, we focused on how the nonlinear processes are affected by the symmetry breaking. The intensity of the symmetry breaking was scanned in the simulation as a control parameter, and the change in the turbulence state was investigated. It was discovered that the macroscopic vortex was driven in the absence of asymmetry, and, as the asymmetry increased, the nonlinear properties of the turbulence changed, driving the flow that suppressed the transport. This is because the turbulence eddies worked to relax the asymmetry density profiles, generating the turbulence stresses that produced the flow. This study demonstrated that the symmetry breaking plasma source can function as a control knob for the plasma confinement.

Keywords : turbulence simulation, plasma, fusion, nonlinear process, spatial symmetry

対称性を破る粒子ソース存在下における円筒磁化プラズマ中 抵抗性ドリフト波の非線形シミュレーション

核融合プラズマでは、粒子や熱の定常的な外部供給が必要不可欠である。これらの粒子・熱の供給は、本質的にプラズマが本来持つ空間対称性を破る。このような空間非対称性はしばしば観測されているものの、乱流輸送研究では考慮されていなかった。そこで、本研究では、空間非対称な定常的粒子供給を乱流シミュレーションに導入した。粒子供給があると、プラズマの密度が上昇し、密度の空間不均一性によって抵抗性ドリフト波と呼ばれる波が発生し、それが乱流化することで粒子輸送が生み出される。従来研究では、乱流の非線形性により巨視的流れや渦構造が駆動され、それによって粒子輸送が大きく変化することが指摘されており、その過程が空間非対称性でどのように影響を受けるかに着目した。シミュレーションでは、空間非対称性の強度をパラメタとしてスキャンする事で、系統的に乱流状態の変化を調査した。非対称性が存在しない場合、巨視的渦が駆動されていたが、非対称性強度を上げていくと、輸送抑制効果を持つ流れの駆動へと、乱流の非線形過程が変化することを発見した。非対称な密度分布を緩和させるような乱流渦が駆動される事で、巨視的流れを生み出す乱流応力が生まれている事が分かった。本研究により、外部供給の空間構造はプラズマの閉じ込め特性の制御ノブとしての機能を持ち得る事を示した。

キーワード：乱流シミュレーション、プラズマ、核融合、非線形過程、空間対称性

Journal（掲載誌）
Physics of Plasmas, 30, 082302 (2023)

Mizuhiko MINAMIYAMA

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Mizuhiko Minamiyama is a Professor at the Department of Civil Engineering, College of Industrial Technology, Nihon University (NIT). He received his PhD from Hokkaido University in 2018. He worked for the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) (formerly Ministry of Construction) from 1988 to 2022 and for the Tokyo Metropolitan Sewerage Service Corporation (TGS) from 2022 to 2023. While working at the Public Works Research Institute (PWRI) and the National Institute for Land and Infrastructure Management (NILIM) of MLIT, his major research topics were the development of wastewater treatment technologies for small-scale sewage works, the development of technologies for the utilization of water, material, energy, and information resources related to wastewater systems, water quality risk management from a watershed perspective, and technology development policies for sustainable sewage works. Since 2023, he has been conducting research at NIT on the realization of sustainable infrastructure systems, mainly sewage works, from the perspective of achieving carbon neutrality, promoting resource recycling, and conserving the water environment. He has also been engaged in research on wastewater system technology for developing countries. He is registered as a Professional Engineer, Japan (Water Supply & Sewerage, Engineering Management). He is a member of the International Water Association (IWA), the Society of Chemical Engineers, Japan (SCEJ), the Japan Society on Water Environment (JSWE), the Society of Environmental Instrumentation Control and Automation (EICA), the Japan Sewage Works Association (JSWA), and the Japan Society of Civil Engineering (JSCE).

Research Achievements

1) Estimation of Greenhouse Gas Emissions from Sewerage Sector in FY2050 and Assessment of Priority in the Countermeasure Fields for Sewerage Sector, *Journal of Japan Sewage Works Association*, Vol. 60, Issue 726, pp.141-149, Apr. 2023 (in Japanese).
2) Applicability of Mathematical Model for Biomass Production by Indigenous Microalgae Based on Cultivation Characteristics at Different Wastewater Treatment Plants, *Journal of Water and Environment Technology*, Vol. 15, Issue 2, pp.43-54, Apr. 2017. (The WET Excellent Paper Award, JSWE)
3) Field survey of pollutants discharged from different types of residential area in the Yamuna River Basin, India, *Water Science and Technology*, Vol. 64, Issue 11, pp.2207-2216, Dec. 2011.
4) Japan: General, in "Global Atlas of Excreta, Wastewater Sludge, and Biosolids Management: Moving Forward the Sustainable and Welcome Uses of a Global Resource," pp.350-356, UN-HABITAT, 2008.
5) Behavior of Pathogenic Microbes in a Treated Wastewater Reuse System and Examination of New Standards for the Reuse of Treated Wastewater, *Environmental Monitoring and Assessment*, Vol. 129, Issue 1-3, pp.43-51, June 2007.

Work Introduction

Water quality risk management as a watershed management

A wide variety of chemical substances are used in the socioeconomic activities of humankind. These substances are considered to be essential elements for a healthy and prosperous society. However, it is increasingly pointed out that substances contained in household products, substances used for medical and health purposes, and substances related to human life activities themselves such as endocrine disruptors (EDs), have the potential to affect the ecosystem. It is very difficult to control the release of these substances into the environment. With the spread of wastewater systems, some of these substances may flow into sewers with wastewater and be discharged into public water bodies via wastewater systems. Therefore, it is necessary to understand the fate of various substances in the wastewater systems and their discharge into the environment, including pollutants that should be treated in the wastewater system, hazardous substances whose discharge into the sewers are regulated, and household substances discharged into the sewers. It is then necessary to take measures such as establishing monitoring and control methods for substances that need to be addressed. Specifically, this involves developing analytical methods for sewage and environmental samples, clarifying the actual conditions of their existence and their fate in the wastewater systems, developing countermeasures, and assessing their impact on humans and ecosystems. Against this background, I conducted research to develop analytical methods for EDs in sewage sludge samples and to clarify the fate of EDs in the sewage sludge treatment process and at the site where composted sewage sludge is applied. These studies were carried out at the Public Works Research Institute (PWRI) with many researchers in cooperation with sewage works administrators. It has recently been pointed out that substances such as perfluoroalkyl and polyfluoroalkyl substances (PFAS) and microplastics have adverse effects on humans and the environment. Some researchers have also pointed out that the excessive focus on certain substances has led to a lack of information on many other substances, which is a potential risk to humans and ecosystems in the future. Related research areas are broadening and deepening, such as the development of evaluation methods from the perspective of biological effects such as whole effluent toxicity (WET) tests, and the One Health approach including research on antimicrobial resistance (AMR). It would be beneficial to continue efforts to clarify the role of wastewater systems in the fate of chemical substances in a watershed, as well as to consider the social role of sewage works in water quality risk management.

下水道システムの水系水質リスク管理における役割

人々の社会経済活動を通じ、多種多様な化学物質、医薬品等が利用されている。これらの物質の一部は排水とともに下水道に流入し、下水道施設等を経由して公共用水域に放流される可能性がある。そのため、多種の物質の下水道システムにおける挙動と環境への排出等の状況を把握し、その監視方法や制御方法の確立など、必要な対策につなげる必要がある。

Journal（掲載誌）

Journal of Japan Society on Water Environment, 41(6), 179-191, Nov. 2018 (in Japanese).
Journal of Japan Society of Civil Engineers, Ser. G, 74(1), 25-34, Mar. 2018 (in Japanese).
Environmental Monitoring and Assessment, 189, Article 442, Sept. 2017.
Journal of Japan Sewage Works Association, 54(652), 89-96, Feb. 2017 (in Japanese).
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Water Science and Technology, 57(2), 167-174, Jan. 2008.
Water Science and Technology, 53(11), 221-226, May 2006.
Environmental Engineering Research, 41, 497-506, Nov. 2004 (in Japanese).
Journal of Sewerage, Monthly, 19(8), 14-21, May 1996 (non-peer-reviewed, in Japanese).

Tomoaki NAKAMURA

Associate Professor, Department of Civil Engineering

Tomoaki Nakamura is an Associate Professor at the Department of Civil Engineering, College of Industrial Technology, Nihon University. He received his BLA (Bachelor of Landscape Architecture) in Civil Engineering from Nihon University in 2006 and his PhD from the Advanced Research Institute of Science and Technology, Nihon University in 2011. Dr. Nakamura worked for Tokyo Electric Power Environment Engineering Corporation from 2011 to 2014, where he was simultaneously engaged in environmental assessments of power plants and harbor facilities. His work includes the dynamic analysis of microplastics, the relationship between marine animals and the environment in coastal areas, and the construction of a model for ocean dispersion of radioactively contaminated water. He is a member of JSCE, JSMST, and JSIA.

Research Achievements

1) MICOPLASTIC POLLUTION IN THE LOWER EBI RIVER, *Journal of Hydraulic Engineering (JSCE)*, in press, 2025.
2) STUDY OF UNDERSTANDING THE DISTRIBUTION OF SCOPIMERA GLO-BOSA HABITAT USING MACHINE LEARNING, *Journal of Ocean Engineering (JSCE)*, Vol.80, No.18, 24-18132, 2024.
3) DYNAMIC ANALYSIS OF MICROPLASTICS IN TOKYO BAY CONSIDERING SEDIMENTATION PROCESS, *Journal of Ocean Engineering (JSCE)*, Vol.80, No.18, 24-18131, 2024.
4) SURVEY OF DAMAGE IN THE NORTHWESTERN COASTAL AREA OF THE NOTO PENINSULA CAUSED BY 2024 NOTO PENINSULA EARTHQUAKE, *Journal of Ocean Engineering (JSCE)*, Vol.80, No.18, 24-18031, 2024.
5) HABITAT SUITABILITY INDEX MODEL OF *MACROPHTHALMUS JAPONICUS, Impact Assessment*, Vol.22, Issue 2, pp.39-44, 2024.

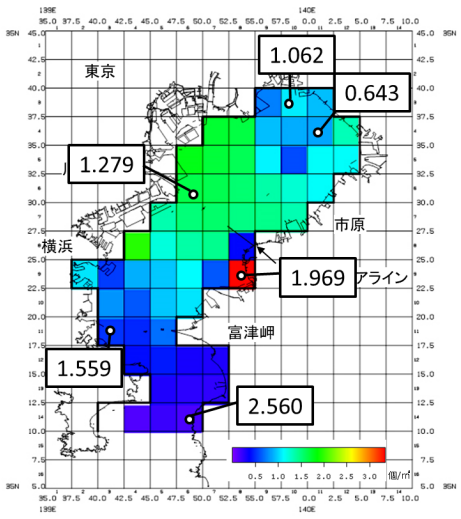


Fig.1 Microplastics distribution (Tokyo Bay)

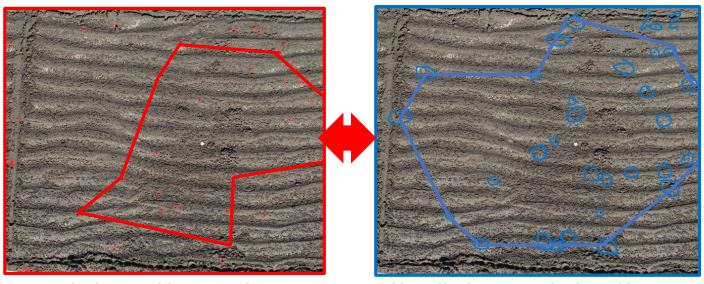


Fig.2 Understanding habitat distribution using deep learning

Fig.3 Ground upheaval in the harbor due to the Noto Peninsula earthquake

Published Paper

Dynamic analysis of microplastics in Tokyo Bay considering sedimentation process

Tomoaki NAKAMURA, Syogo ARIYAMA, Hirokazu SUMI, Akira ODA and Minoru OCHIAI

There are concerns about microplastics (MPs) that have flowed into the ocean. In this study, we attempted to elucidate the process by which MPs flow from land into Tokyo Bay based on regular surveys of the sediment in the Ebi River. The results showed that the number and types of MPs fluctuate greatly over time, but that seasonality is small, and that when a typhoon passes, the number of MPs increases to 75 times the normal amount. We also found that more than 90% of the MPs in the Ebi River are plastic fragments, with little artificial turf or fibers. Based on these results, the dynamics of marine microplastics in Tokyo Bay, which have been a concern for marine organisms, were analyzed using a mathematical model. In this study, three equations (dissolved form, small particles with sedimentation rate, and large particle adsorption state) were constructed for microplastics loaded from rivers in Tokyo Bay, and a number density analysis method was developed by considering the adsorption/desorption, mineralization, and sedimentation effects among them. The distribution coefficients of microplastics were parameterized with reference to dioxins. When the distribution coefficient was 20 times larger than that of dioxins, the number density analysis of microplastics in Tokyo Bay demonstrated high reproducibility compared to the measured data. The analysis results showed that the discharge of microplastics into the bay was about 30%.

Keywords: Microplastics, Tokyo Bay, settling to the seabed, distribution coefficient

東京湾におけるマイクロプラスチックの沈降過程を考慮した動態解析

近年では海洋に流入したMPsへの懸念がされている．しかしながら河川底質におけるMPsの汚染実態を把握した事例は少なく，特に継続的な調査によるMPsの個数，種類，サイズの時間変動は不明である．本研究では，海老川の定期的な調査を基にMPsが陸域から東京湾へ流入する過程の解明を試みた．その結果， MPsの個数および種類は時間と共に大きく変動しているが，季節性は小さく，台風通過時にはMPsが通常の75倍に増えることが分かった．また，海老川におけるMPsの形状は90%以上がプラ片で，人工芝や繊維は少ないことが分かった．

この結果を踏まえて，東京湾における河川からの流入後の動態解析を数理モデルにより実施した．本研究は東京湾を対象として，河川から負荷されるマイクロプラスチックについて，3つの式（溶存態，小粒子及び沈降速度を持つ大粒子吸着態）を組み立て，それぞれの間で吸着・脱着，無機化や沈降の作用を考慮して個数密度の解析手法の展開を図った．マイクロプラスチックの分配係数については，ダイオキシン類を参考にパラメタ解析を実施した．

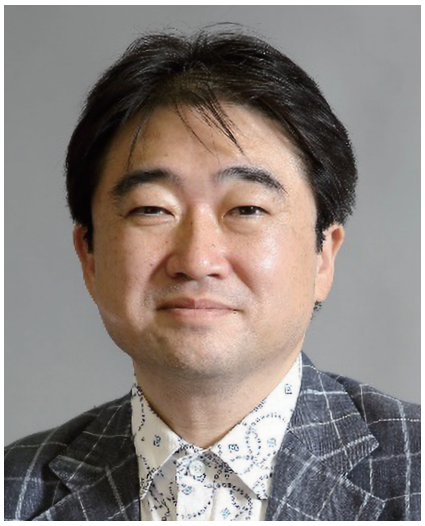
その結果，分配係数がダイオキシン類の20倍であった時，東京湾におけるマイクロプラスチックの個数密度解析結果は実測値と比較して，高い再現性を示した．解析結果から，マイクロプラスチックの湾外への流出が30％程度であることが分かった．

キーワード：マイクロプラスチック，東京湾，海底への沈降作用，分配係数

Journal（掲載誌）
Journal of Ocean Engineering (JSCE), Vol.80, No.18, 24-18131, 2024.

Noboru YUASA

Professor, Department of Architecture and Architectural Engineering



Noboru Yuasa is a Professor at the College of Industrial Technology, Nihon University. He earned his BEng in 1988 from Hokkaido University and his MEng in 1990 from the Tokyo Institute of Technology, after which he moved to Nihon University as a Research Associate. He received his EngD degree from Nihon University in 1998 for "A Fundamental Study on the Quality of Surface Layer Concrete." He was promoted to Lecturer in 1998, Associate Professor in 2003, and Professor in 2011. Dr. Yuasa has studied "surface layer concrete" from the point of view of moisture content and porosity as his life's work. He received the 2019 AIJ Prize (Research Theses Division) from the Architectural Institute of Japan for "A SERIES OF STUDY ON SURFACE LAYER CONCRETE QUALITY." His current research topics include the durability of concrete structures and finishing materials, non-destructive testing methods, demolition of structures, earthquake resistance improvement for buildings in developing countries, and investigation of historical buildings. He has participated in several international research projects for Santuario di Vicoforte and L'Hangar per dirigibili di Augusta; 2002–03 and 2006–08, Sant'Agostino, San Silvestro e Torre Civica in L'Aquila; 2010–14, Italy, Spain, Portugal; 2016–21. He has also participated in the Bhutan Project by JST/JICA SATREPS (Science and Technology Research Partnership for Sustainable Development). While engaged at Nihon University, he was also a visiting researcher for one year at the University of Dundee, England in 2011. He has served as a chairman, secretary, and research leader of many committees of the Architectural Institute of Japan, the Japan Concrete Institute, the Japan Cement Association, the Japan Society for Finishing Technology, and the Japanese Society for Non-Destructive Inspection.

Research Achievements

1) N. Yuasa, Y. Kasai and I. Matsui: Inhomogeneous Distribution of Moisture Content and Porosity in Concrete, CREATING WITH CONCRETE, Concrete durability and repair technology, pp.93-101, September 1999

2) N. YUASA, Y. KASAI and I. MATSUI: Inhomogeneous distribution of compressive strength from the surface layer to internal parts of concrete in structures, CANMET/ACI/JCI, Fifth International Conference on Durability of Concrete, pp.269-281, 2000.6

3) N Yuasa, Y Kasai, I Matsui and E Kamada: Freeze-Thaw Resistance of Concretes Subjected to Drying at Early Ages, Challenges of Concrete Construction, Concrete Technology Unit, University of Dundee, Concrete for Extreme Conditions, pp.437-446, September 2002

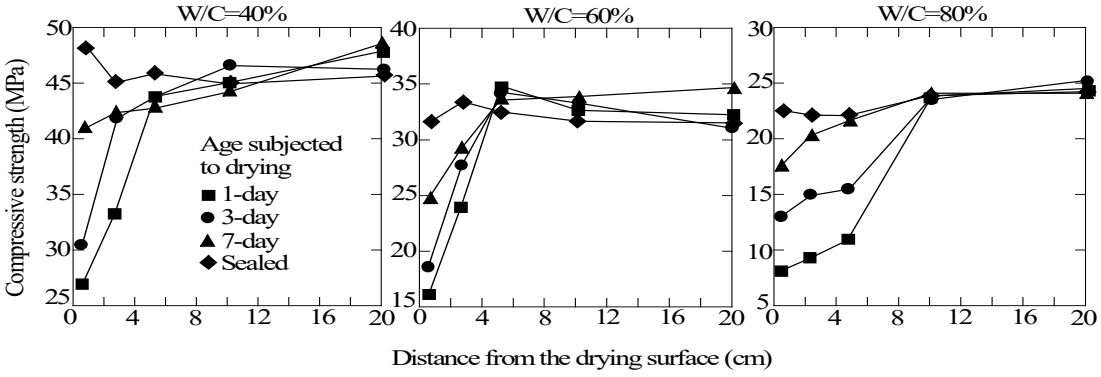


Figure Distribution of compressive strength as a function of the distance from the drying surface.

Document

State of the Art of Non-Destructive Testing Methods for Concrete Structures in Japan

Noboru YUASA

Interest in “diagnosis” of actual reinforced concrete structures has increased recently in Japan, with the shift from “scrap and build” to “construction of a long-life, resource-recycling society”, and many non-destructive tests have been developed, maintained and used. The use of φ100mm concrete core sampling is evaluated as a destructive test although it is on a small scale and reliable. Destructive test involves large-scale work and repairs, leading to high cost burden without obtaining a large amount of data, and its information tends to be a single point significance. Although non-destructive testing allows evaluation using multiple data, it is not a panacea, and the reality is that, in many cases, we have no choice but to rely on destructive testing in the end, considering accuracy first. If universal physical properties can be directly tested, there is no problem but the important point of non-destructive testing is the estimation of a property by testing the other properties that closely related to the target property. The user’s understanding of existing test methods is more important than further or new development of test methods.

For a better understanding of non-destructive testing, this article first introduces the actual conditions of concrete structures, and then explains the current state of existing non-destructive testing methods, focusing on those standardized by the Japan Non-Destructive Inspection Association, and finally the future prospects of non-destructive testing.

Keywords: Concrete Structure, Non-Destructive Testing Method, Strength, Deterioration, Moisture Content

日本におけるコンクリート構造物の非破壊検査・最近の動き

日本では，近年，「スクラップ＆ビルド」から「超寿命化・資源循環型社会の構築」への移行にあたり，鉄筋コンクリート実構造物の「診断」に関する関心が高まり，実に多くの非破壊試験が考案・整備・使用されている。φ100mmコンクリートコアは，その結果の信頼性は評価されるものの，小規模ではあるが破壊試験とされる。破壊試験と位置づけられる試験は，大がかりな作業や補修を伴い，それがまた高価な費用負担につながることから多数のデータを得ることはできず，点としての情報となる傾向にある。しかし，非破壊試験によれば多数データによる評価が可能である。

しかしながら，非破壊試験は万能ではなく，精度を第一に考えて，やはり最後は破壊試験に頼らざるを得ないことが多いのも実態である。非破壊試験の重要な勘所は，普遍的な物性値をストレートに近い状態で試験・評価できる場合はいいとして，その物性値に関連深いコンクリートの他の物性を測定することにより類推して評価できるかである。だから必然的に万能ではない。更なる試験方法の開発・発展の重要性もさることながら，使用者の既存の試験方法に対する理解こそ極めて重要といえる。

本資料では，非破壊試験のよりよい理解のために，コンクリート構造物の実態を紹介した上で，日本非破壊検査協会で規格となった試験方法を中心に，日本における既存の非破壊試験の現状を解説し，最後に非破壊試験の将来展望について言及した。

キーワード：コンクリート構造物，非破壊試験，強度，耐久性，含水率

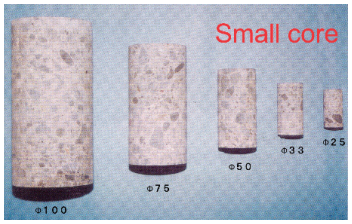


Figure Small sized cores

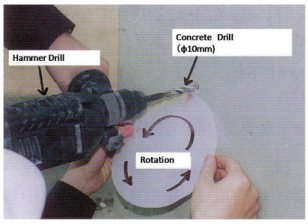


Figure Neutralization measurement using powder from drilled hole: NDIS 3419-1999

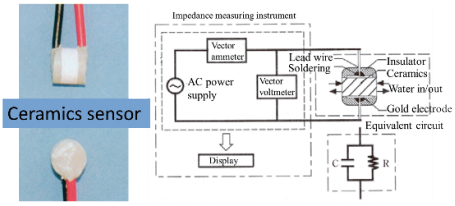


Figure Embedded Ceramics Sensor

Journal（掲載誌）
Noboru YUASA: State of the Art of Non-Destructive Testing Methods for Concrete Structures in Japan, Journal of the College of Industrial Technology, Nihon University, Vol.57, No.1, pp.11-31, 2024.6, https://www.cit.nihon-u.ac.jp/laboratorydata/kenkyu/publication/journal_a/a57.1.2.pdf

Takahisa KAMADA

Assistant Professor, Department of Architecture and Architectural Engineering

Takahisa Kamada received his Master of Agriculture degree from Shizuoka University Graduate School of Agricultural Science in 2004, and he joined Noda Corporation, a manufacturer of building materials, in the same year. In 2007, he entered the United Graduate School of Agricultural Sciences, Gifu University (Shizuoka University placement), and in March 2012, he was awarded a doctorate in Agricultural Science for "Pseudo dynamic test and time history earthquake response analysis." In 2012, he was employed as a fixed-term Assistant Professor at the Institute of Wood Technology, Akita Prefectural University and in April 2013, he was employed at the Department of Architectural Engineering, College of Industrial Technology, Nihon University, where he is currently working. His main research interests are related to wooden houses, and his recent research is on shear walls and microvibration of houses. He is a member of the Architectural Institute of Japan, the Japan Wood Research Society, and the Wood Technological Association of Japan.

Research Achievements

1) Relationship between the Vertical Load Properties of Floors and Human Sensory Evaluations of Walking Vibration in Wooden Schools and Offices II. Possibility of a tentative design target for large-span wooden floors according to human sensory evaluations of walking vibration, Mokuzai Gakkaishi,Vol. 63, No. 2, p. 98－107（2017）(in Japanese)
2) Relationship between Vertical Load Properties of Floors and Human Sensory Evaluation of Walking Vibration in Wooden Schools and Offices I. Static and dynamic properties of large-span wooden floors, Mokuzai Gakkaishi, Vol. 62, No. 4, p. 101－107（2016）(in Japanese)
3) Property of Structural Panels using on conventional wooden houses, AIJ J. Technol. Des. Vol. 21, No.47, 105-108, Feb., 2015 (in Japanese)

Published Paper

AMPLIFICATION CHARACTERISTICS OF THE HORIZONTAL VIBRATION ON ROAD TRAFFIC VIBRATION TO WOODEN HOUSE

Kiyoshi INA, Keisuke FUJIMOTO, Noboru NAKAMURA, Takahisa KAMADA, Eiichi FUJINO

Vibration measurements were taken on 32 wooden houses to estimate the amplification factor in the buildings due to traffic vibration. The results showed that the amplification factor decreased with higher input vibration.

High-frequency components were not input to the buildings and their amplification was found to be smaller.

In high-strength buildings with many shear walls, a negative correlation between the input vibration and the response was observed in a specific frequency band. It was concluded that it is difficult for load-bearing walls to control traffic vibration, which is a minute deformation.

Keywords: Road traffic vibration, horizontal vibration, wooden house, acceleration vibration level, internal amplification

道路交通振動における木造住宅の水平振動の増幅特性

32棟の木造住宅に関して、振動計測を行い、交通振動による建物内の増幅率を推定した結果、増幅率は、入力振動が大きいほど低下した。

高周波成分は、建物に入力されず、その増幅は、小さくなることがわかった。

また、多くの高耐力壁の配置される建物では、特定周波数帯域で入力振動と応答に負の相関が見られた。また、耐力壁では、微小な変形である交通振動を制御することは難しいと考えられる結論に至った。

キーワード：交通振動，水平振動，木造住宅，振動加速度レベル，内部増幅

Journal（掲載誌）
AIJ J. Technol. Des. Vol. 26, No.64, 984-989, Oct., 2020 DOI https://doi.org/10.3130/aijt.26.984

Tatsuro NAKAGAMA

Professor, Department of Applied Molecular Chemistry

Tatsuro Nakagama is a Professor at the Department of Applied Molecular Chemistry, College of Industrial Technology, Nihon University. He graduated from Tokyo Metropolitan University in 1989. From 1989 to 1992, he worked in the analytical division of Sandoz Pharmaceutical Co. (now Novartis Pharma Co.). Since 1992, he has been a Research Associate in the Division of Applied Chemistry at Tokyo Metropolitan University. He has also been a visiting researcher in the Organic Analytical Chemistry Division at the National Metrology Institute of Japan since 2002. He moved to Nihon University as an Associate Professor in 2008 and has held his current position since 2013. His main research interests are the development of environmentally friendly microextraction or chromatography methods, and detection methods using microplasma. Recently, he developed learning materials and teaching methods for engineering undergraduates to study chemistry.

Research Achievements

1) Preparation of a Flow Single-drop Extraction System for Educational Use Capable of the Simultaneous and Continuous Observation of Extraction Behavior and Absorbance Change, Journal of Japanese Society for Engineering Education, 71(3), 14-19, Jun 2023.
2) Preparation and Practice of a Simple Educational Tool for Learning Electronic Configuration of Atoms and Molecules, Journal of Japanese Society for Engineering Education, 70(2), 8-13, Mar 2022.
3) Preparation of a Simple Simulation material for Learning Plate Theory by Visualizing the Mass Transfer and Mass Valance, Journal of Japanese Society for Engineering Education, 68(2), 33-39, Mar. 2020.
4) Accurate Nano-injection System for Capillary Gas Chromatography, Journal of Chromatography A, 1216(15), 3337-3342, Feb. 2009.
5) Monitoring Nano-flow Rate of Water by Atomic Emission Detection Using Helium Radio-frequency Plasma, Analyst, 128(6), 543-546, Apr. 2003.

Published Paper

Preparation of a flow single-drop extraction system for educational use capable of the simultaneous and continuous observation of extraction behavior and absorbance change

Tomone OSAKO, Yoshiharu ITO, Hiroaki MINAMISAWA and Tatsuro NAKAGAMA

Liquid-liquid extraction is used in engineering for separation and purification of chemical substances, and in analytical chemistry for pretreatment and concentration in the analysis of environmental pollutants. In chemistry studies at high schools and universities, demonstration experiments on the extraction of dyes from aqueous solutions to organic solvents using glass separating funnels and test tubes are used to visualize the phenomena. However, the transportation and preparation of fragile experimental apparatus are complicated, and there are concerns about the effects of volatilization of the extraction solvent on the health of the students. In addition, it is difficult to directly connect theory and phenomena because quantitative information on dyes cannot be obtained by visual observation. In this study, we developed a portable flow single-drop extraction system that can be used for experiments in a closed system with a very small amount of organic solvent and can also measure dye concentrations. This system consists of a pump for circulating the sample solution, a ring-shaped extraction cell with a droplet injection port, a flow cell for absorbance detection, a light source, a CCD spectrometer, a USB camera, and a laptop PC. The system weighs less than 10 kg and can be stored in a portable case. The system can project the image of droplets in the extraction cell and the absorption spectrum or absorbance in the detection cell on the same screen, such as a PC or projection screen. Therefore, the color change of the droplet and the absorbance change of the sample solution during the extraction process and the absorbance of the droplet after extraction can be observed simultaneously and continuously on the same screen. The absorbance of the sample solution and droplet measured by this system follows Lambert-Beer's law, and the dye can be quantified from the absorbance. Furthermore, it was suggested that the material balance in the extraction can be calculated from the decrease in absorbance of the circulating dye solution and the absorbance of the droplet after extraction.

Keywords: Extraction behavior, absorbance change, simultaneous and continuous observation, educational use, flow single-drop extraction system

抽出挙動と吸光度変化の同時連続観察が可能な教育用フロー単一液滴抽出装置の試作

液-液抽出は工学的に化学物質の分離，精製など，分析化学的には環境汚染物質分析での前処理，濃縮などにそれぞれ利用されている。高校や大学での化学学習においては，現象のイメージ付けのためにガラス製の分液漏斗や試験管を用いた色素の水溶液から有機溶媒への抽出に関する演示実験が行われる。しかしながら，壊れやすい実験器具の運搬や準備は煩雑であり，抽出溶媒の揮発により受講者の健康への影響が懸念される。また，目視観察では色素の定量的な情報を取得できないために理論と現象を直接結びつけることは困難である。そこで，本研究では極微少量の有機溶媒を用いて閉鎖系の実験が可能であり，かつ色素濃度が測定できる可搬型フロー単一液滴抽出装置を試作した。この装置は試料溶液を循環させるためのポンプ，液滴導入部を備えたリング状抽出セル，吸光度検出用フローセル，光源，CCD分光器，USBカメラおよびノートPCにより構成される。本装置は10kg以下であり，持ち運び可能なケースに収納できる。本装置は抽出セル中の液滴の映像と検出セルでの吸収スペクトルあるいは吸光度をPCやプロジェクタースクリーンなどの同一画面上に投影できる。したがって，抽出過程での液滴の呈色と試料溶液の吸光度変化や抽出後の液滴の吸光度を同一画面上で同時かつ連続的に観察することができる。検討の結果，本装置において測定した試料溶液および液滴の吸光度はランベルト－ベールの法則に従い，吸光度から色素の定量が可能であった。さらに，循環している色素水溶液の吸光度低下と抽出後の液滴の吸光度から，抽出における物質収支が算出できることを示唆した。

キーワード：抽出挙動，吸光度変化，同時連続観察，教育用，フロー単一液滴抽出装置

Journal（掲載誌）
Journal of Japanese Society for Engineering Education, 71(3), 14-19, Jun 2023.

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Research Achievements

1) Ultrasound-induced Circularly Polarized Luminescence Based on Homochiral Aggregation of Clothespin-Shaped Pt(II) Complexes, *Responsive Mater*. **2024**, *2*, e20240017.
2) Switching of Circularly Polarized Luminescence via Dynamic Axial Chirality Control of Chiral Bis(Boron difluoride) Complexes with Salen Ligands, *ChemPhotoChem* **2024**, *8*, e202400110.
3) Linker-dependent control of the chiroptical properties of polymethylene-vaulted *trans*-bis[(*β*-iminomethyl) naphthoxy]platinum(II) complexes, *Dalton Trans*. **2024**, *53*, 7775–7787.
4) Circularly polarized phosphorescence with a large dissymmetry factor from a helical platinum(II) complex, *Chem. Commun*. **2024**, *60*, 2413–2416.
5) Circularly Polarized Luminescence from Schiff-base [4]Helicene Boron Complexes, *Chem. Asian J*. **2024**, *19*, e202301024.

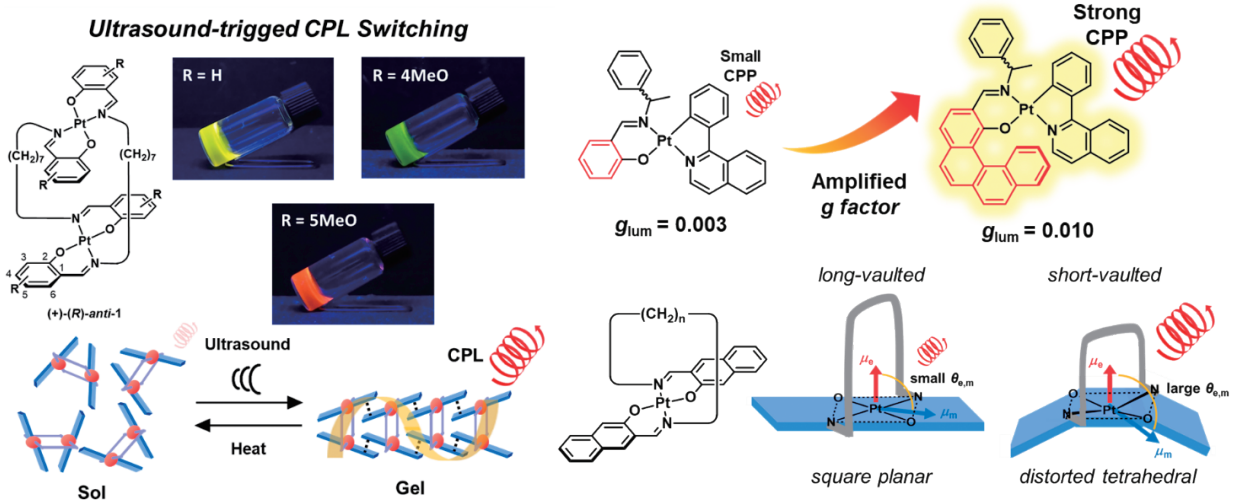

Fig. 1 Representative examples of CPL (Circularly Polarized Luminescence)-active platinum(II) complexes.

Published Paper

Circularly polarized phosphorescence with a large dissymmetry factor from a helical platinum(II) complex

Masahiro IKESHITA, Shinya WATANABE, Seika SUZUKI, Shota TANAKA, Shingo HATTORI, Kazuteru, SHINOZAKI, Yoshitane IMAI, and Takashi Tsuno

This paper describes the synthesis, structure, and circularly polarized phosphorescence (CPP) properties of a helical platinum(II) complex. A series of optically pure platinum(II) complexes were synthesized and characterized by nuclear magnetic resonance (NMR) and X-ray diffraction (XRD) analysis. In solution, the complexes exhibited diastereomeric equilibrium based on helical inversion, and their three-dimensional molecular structures were analyzed by two-dimensional (2D) and variable temperature (VT)-NMR spectra. Intense red phosphorescence was observed in dilute CH_2Cl_2 solutions and the CPP spectra of optically pure samples were measured. Notably, the helical complexes exhibited CPP with g_{lum} values up to the order of 10^{-2}, which is the highest value of any phosphorescent platinum(II) complexes observed in the isolated solution state. Density functional theory (DFT) and time-dependent (TD)-DFT calculations of the structures and electronic configurations of the complexes revealed a relationship between the helical structure and the chiroptical properties.

Keywords: Circularly polarized phosphorescence, circular dichroism, chiral, helicity, platinum complexes

らせん状白金 (II) 錯体からの巨大な異方性因子を有した円偏光燐光

本論文は高い異方性因子を有した円偏光燐光を示すらせん状白金（II）錯体について述べている。燐光性のキラル色素は円偏光燐光（CPP : Circularly Polarized Phosphorescence）と呼ばれる右または左円偏光のどちらかを過剰に含む燐光を発することが知られている。CPP材料はエネルギー変換効率の観点から円偏光有機EL（CP-OLED）への応用が期待されており、高輝度なCPPを発する材料の開発が望まれる。一般的にCPP材料の性能は異方性因子（g_{lum}）で評価され、これは左右円偏光強度の差分を全体の強度で割った値となる。これまでに報告されているほとんどのCPP材料は10^{-3}オーダーのCPPを発することが知られており、これは左右円偏光の強度差が1000分の1程度であることを示している。CPP材料を実用化するためには、如何にg_{lum}を向上させるかが最も重要な課題となっており、そのための分子設計指針の確立が待ち望まれている。

そこで本研究では、1-フェニルイソキノリン（piq）を*C^N*二座配位子として導入したキラル白金（II）錯体を新たに合成し、CPP特性の調査を行った。その結果、らせん状の配位子を導入した錯体が、従来材料を凌ぐ10^{-2}オーダーのCPPを発することを見出した。合成した錯体は核磁気共鳴（NMR）分析および単結晶X線構造解析（XRD）によって同定された。興味深いことに、(*S*)-体の不斉炭素を有するらせん状白金（II）錯体は、単位格子内で右巻き（(*P*)-体）の一方方向のヘリシティーを保持したまま晶析していた。一方、溶液中においては (*S*,*P*)-体及び (*S*,*M*)-体のジアステレオマー平衡を示し、NMRスペクトルの積分比からジアステレオマーの存在比率は溶媒に極性に依存して変化することが判明した。続いて希薄溶液状態において発光スペクトル測定を行ったところ、608 nmを極大発光波長とする赤色燐光発光が確認された。また、同条件下におけるCPLスペクトルを測定したところ、それぞれのエナンチオマーが鏡像関係となるシグナルを示し、g_{lum}値は1.0×10^{-2}と算出された。密度汎関数理論（DFT）計算により、この10^{-2}オーダーに迫る高い異方性は、らせん状分子骨格のキラリティーに誘起されていることが考えられる。本研究により、燐光性錯体におけるらせん状の分子設計がCPP特性の向上に有利となることが実証された。

キーワード：円偏光燐光，円偏光二色性，キラル，ヘリシティー，白金錯体

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Research Achievements

1) A Butterfly Catastrophe Model for Appointing Skilled Contractors as "Regular Employees," *Journal of Japan Association for Management Systems*, Vol.40, No.1, pp.63-69 (2023)
2) A Catastrophe Model of Consumers' Environment-oriented Behavior, *Journal of Japan Society for Business Ethics*, Vol.27, pp.163-168 (2020)
3) Rationality of Maximum Entropy Principle in Expanded Reasoning and Elimination of Bias Information, *Journal of Japan Association for Management Systems*, Vol.36, No.3, pp.183-188 (2020)
4) Quantitative Analysis of Positive and Negative Feelings in the Menu Selection Behavior of Consumers, *International Journal of Japan Association for Management Systems*, Vol.11, No.1, pp49-54 (2019)
5) An Analysis Model for Externalization Strategy of Geographical Concept in Restaurant, *Journal of Japan Association for Management Systems*, Vol.34, No.3, pp.267-272 (2018)

Published Paper

Quantitative analysis of positive and negative feelings in the menu selection behavior of consumers

Sunhee KWON, Takaaki KAWANAKA and Hiroshi YAMASHITA

This study focuses on consumers' emotional states (both positive and negative) and analyzes the effect that consumers' emotional states have on their menu selection behavior, along with the impact that this has on how messages (fuzzy messages) are received. To achieve this, we first test subjects by evoking certain feelings through the application of different stimuli. For positive feedback, we play music to test the subjects; for negative feedback, we expose the subjects to a noise source. Next, we conduct a questionnaire on the attractiveness of a restaurant menu using the menu profile designed by the $L_8(2^7)$ type orthogonal array of the experimental design method, and analyze the collected data. As a result, the following findings were obtained. 1) The message "a restaurant that people line up for" is effective to subjects. 2) Subjects are not especially affected by high price, particularly when they are in a positive emotional state. 3) In negative emotional states, menu profile has more impact than the message (fuzzy message).

Keywords: Evocation of Feelings, Emotional State, Consumer Behavior, Design of Experiments, Fuzzy Message

消費者のメニュー選択行動における ポジティブ感情とネガティブ感情の定量的分析

本研究では，消費者のポジティブな感情状態とネガティブな感情状態に注目しながら，これらの感情が消費者のメニュー選択行動に与える影響と消費者の受信するメッセージの印象に与える影響を定量的に分析することを試みる．そこで，まず感情を誘導する刺激を与える実験により，被験者に新たな感情を喚起させることにする．その際，ポジティブな感情を誘導する刺激としてクラシック音楽を，またネガティブな感情を誘導する場合は騒音（工事現場における削岩機の音）を聞かせることにする．さらに，実験計画法の$L_8(2^7)$型直交配列表によりデザインしたメニューのプロファイルを用いて，メニューの魅力度を調査し，ファジィ理論に基づく実証分析を行った．これにより，1)「行列のできるレストラン」というメッセージが魅力度に対して正の効果をもたらす傾向がある，2) ポジティブな感情状態の場合は，高い価格の影響が小さくなる傾向がある，3) ネガティブな感情状態では，メッセージよりもメニューのプロファイルの影響を大きく受ける傾向がある，という知見を得ることができた．

キーワード：感情喚起，感情状態，消費者行動，実験計画法，ファジィ・メッセージ

Journal（掲載誌）
International Journal of Japan Association for Management Systems, Vol.11, No.1, pp49-54 (2019)

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Taisei Inoue is a Research Assistant at the Department of Industrial Engineering and Management, College of Industrial Technology, Nihon University. He received his BEng in 2018, his MEng in 2020, and his PhD in Engineering in 2023, each from Nihon University. Dr. Inoue has been working as a Research Assistant at the Department of Industrial Engineering and Management, College of Industrial Technology, Nihon University since 2023. His major research topics include the estimation of human cognitive characteristics using simple drawing tasks on tablet devices, and the study on genre preference based on personality traits. His research integrates information engineering with human factors and ergonomics, or *Kansei* engineering. He is a member of the Information Processing Society of Japan (IPSJ), the Institute of Image Electronics Engineers of Japan (IIEEJ), the Japan Human Factors and Ergonomics Society (JES), and the Japan Society of Kansei Engineering (JSKE).

Research Achievements

1) Relationship between the Characteristics of Drawn Lines and Reaction Time during Simulated Right Turns at Intersections, Proceedings of 22nd Triennial Congress of the International Ergonomics Association (IEA2024), Aug 2024.
2) Personality-Based Video Game Preference of Young Japanese People, Proceedings of 22nd Triennial Congress of the International Ergonomics Association (IEA2024), Aug 2024.
3) A Study of Young People's Game Preferences – Focusing on the Relationship between Big Five Personality Factors and Game Preferences –, Transactions of Japan Society of Kansei Engineering, 23(3), 265-273, Aug 2024. (In Japanese)
4) The Relationship between the Variation in Drawn Lines and Reaction Time in a Simulated Right Turn Situation, Proceedings of the 8th IIEEJ International Conference on Image Electronics and Visual Computing (IEVC2024), Mar 2024.
5) The Relationship between Line Drawing and Error Proneness in a Line Drawing Task, Human Factors in Japan, 27(1), 27-35, Aug 2022. (In Japanese)

Published Paper

The relationship between line drawing and error proneness in a line drawing task

Taisei INOUE, Noriamsa Yoshida and Motonori ISHIBASHI

To measure the types of error proneness simply and quickly, this study investigates the relationship between the line drawing task, where participants draw their best line based on a point cloud displayed on a tablet, and error proneness. A measure for the drawn line based on the point cloud is proposed, and the relationship between this measure and the scores indicating error proneness is examined. We also clarify which types of point clouds are associated with this relationship. For 10 types of point clouds, 34 participants performed the task three times, with at least one day between sessions. For two specific types of point clouds, we found that the distance from the drawn line to the center of the point cloud (hereafter referred to as the barycenter distance) was correlated with the action slip (AS, a measure of error proneness due to forgetfulness or inattentiveness) score (r=0.57, 0.39, p<0.05). Based on the results of a multiple regression analysis with the barycenter distance as the dependent variable (R^2=0.25, p<0.01), we created a perceptual and cognitive model for the line drawing task. The results of this study suggest that how participants draw lines in the task is related to AS scores and may also be associated with the scores of cognitive narrowing. This study suggests that the line-drawing task can be used as a simple and effective tool for assessing error proneness and cognitive processes.

Keywords : Line Drawing Task, Action Slip, Cognitive Narrowing, Error Proneness Questionnaire

直線描画タスクにおける線の引き方と失敗傾向の関係性

失敗行動のタイプを簡便かつ迅速に測定することを目的として，本研究では，タブレット端末上に表示された点群をもとに直線を引くタスク (以下，直線描画タスク) と失敗傾向との関係を調べる．点群に基づいて引かれた直線の評価尺度を提案し，この尺度と失敗傾向の得点との関連性を検討し，どのような点群が関係しているかを明らかにする．10種類の点群について，34名の実験参加者が1日以上の間隔を空けて3回タスクを実施した．特定の2種類の点群において，引かれた線と点群のx, y座標の重心までの距離 (以下，重心までの距離) とアクションスリップ (AS，物忘れや不注意からくる失敗傾向) の得点に相関があるという結果が得られた (r=0.57, 0.39, p<0.05)．また，重心までの距離を目的変数とした重回帰分析の結果 (R^2=0.25, p<0.01) に基づき，直線描画タスクにおける知覚・認知モデルを作成した．本研究の結果から，直線描画タスクにおける線の引き方がASの得点と関係しており，線を引く際の認知過程で認知の狭窄の得点とも関連する可能性が示唆された．本研究より，直線描画タスクが失敗傾向や認知過程との関連性を評価する簡便な指標として活用できる可能性が示唆された．

キーワード：直線描画タスク、アクションスリップ、認知の狭窄、失敗傾向質問紙

Journal（掲載誌）
Human Factors in Japan, Vol.27, No.1, pp.27-35, Aug 2022. (In Japanese)

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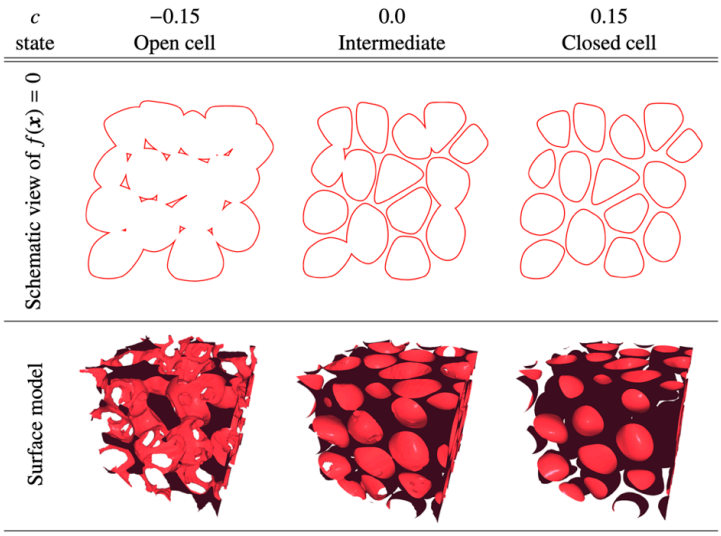
Research Achievements

1) Performance Evaluation of Electromagnetic Shield Constructed from Open-Cell Metal Foam Based on Sphere Functions, Computer Modeling in Engineering & Sciences, 132(1), 43-53, Jun. 2022.
2) Shape Modelling of Metal Foams of Open/Closed States and their Intermediates by Implicit Function, Journal of Advanced Simulation in Science and Engineering, 8(1), 143-153, Jun. 2021.
3) Sphere-Function-Based Shape Modelling of Open Cell Metal Foam with Plateau Borders, Journal of Advanced Simulation in Science and Engineering, 7(1), 89-101, Apr. 2020.
4) Three-Dimensional Shape Modelling of Metal Foam with Rounded Cells by Implicit Surfaces, Journal of Advanced Simulation in Science and Engineering, 6(1), 195-214, May 2019.
5) Efficient Simulation of Electromagnetic Wave Propagation in Complex Shaped Domain by Hybrid Method of FDTD and MTDM Based on Interpolating Moving Least Squares Method, IEEE Trans. on Magnetics, 53(6), Art. no. 7203004, Jun. 2017.

Results of metal foams represented as surface models generated by an RBF-based implicit surface method with $c = -0.15$, 0.0 and 0.15, respectively, and their schematic views of $f(x) = 0$.



Published Paper

Shape modelling of metal foams of open/closed states and their intermediates by implicit function

Yuya HANAOKA, Taku ITOH, Kohei TATEYAMA, Susumu NAKATA, and Keiko WATANABE

In recent years, metal foams have been paid attention because of their light weight and high shock absorption capabilities. They are expected to be employed in various fields. Note that manufacturing metal foams is expensive. Hence, various numerical simulations using metal foam models become increasingly desirable before manufacturing. To improve the accuracy of simulations, models as similar as possible to real metal foams are required. Metal foams mainly have two types of states, closed- and open-cell, and we consider modelling these two states. First, we have proposed a method for generating closed-cell models. Note that real closed-cell metal foams contain a number of rounded cells. In the proposed method, we have generated closed-cell models with rounded shapes of cells, which are similar to those of real metal foams, by an RBF-based implicit surface method.

Next, we have proposed a method for modeling open-cells that employs spheres and CSG (Constructive Solid Geometry). This method enables to generate models that has edges and junctions, which are characteristics of open-cells. In addition, the edges of open-cells have a characteristic that the cross section, called the Plateau border, is a concave triangle, and the edges become thicker as they close to the junction; these characteristics are also reproduced.

The closed- and open-cell modelling methods described above have proposed separately, the spheres, which are used to generate open-cells, are also kinds of implicit surfaces, we have proposed a method to integrate both methods. Specifically, when the initial state of each method is an iso-surface represented by the implicit surface $g(\boldsymbol{x}) = 0$, the initial state is represented as a closed-cell or open-cell dependent on the original modelling method. Note that, by extracting an iso-surface of $g(\boldsymbol{x}) = c$, other result that different from the initial state can be obtained. This indicates that by setting $f(\boldsymbol{x}) = g(\boldsymbol{x}) - c$, any state can be represented as an implicit surface $f(\boldsymbol{x}) = 0$. Indeed, metal foams of intermediates between closed- and open-cell exist, the proposed method enables to represent any levels of intermediates by adjusting the value of c, making it possible to represent various states of metal foams.

Keywords: Metal foams, open-cell, closed-cell, intermediates, implicit function, shape modelling

陰関数による発泡金属の形状モデリング
－オープン / クローズドセル及びその中間状態の生成－

近年，軽量で高い衝撃吸収能力等を有することから，発泡金属が注目されている．多様な分野での使用が期待されているが発泡金属は製造コストが高いため，製造前にシミュレーションによる様々な解析ができることが望ましい．シミュレーションの精度を上げるためには，できるだけ現実の発泡金属に近いものをモデリングする必要がある．発泡金属は，大きく分けて，Closed-cellとOpen-cellの2種類の状態が存在するが，我々はこれら2つの状態をモデリングすることを目的としており，まずはClosed-cellのモデリングを行った．実際のClosed-cellの発泡金属には大量の気孔が含まれるが，RBF (Radial Basis Function)に基づいた陰関数曲面法によって気孔を生成することで，現実の発泡金属に近い丸みを帯びたClosed-cellの気孔形状を表現した．

次にOpen-cellのモデリング法として，球とCSG (Constructive Solid Geometry)を用いた方法を提案した．同方法では，Open-cellの特徴であるEdgeとJunctionのある構造をモデリング可能である．また，Open-cellのEdgeは，Plateau borderと呼ばれる切断面が凹辺三角形になり，Junctionに近づくにつれてEdgeが太くなるという特徴があるが，これらも再現している．

上述のClosed-cellとOpen-cellのモデリング法は別々に考案したが，Open-cell生成に使用した球は陰関数曲面でもあるため，両方法を統合する方法を提案した．具体的には，各方法の初期状態を陰関数曲面$g(\boldsymbol{x}) = 0$で表される等値面としたとき，初期状態は元々のモデリング法に合わせてClosed-cellあるいは Open-cellとして表されるが，$g(\boldsymbol{x})$の値を変化させ，$g(\boldsymbol{x}) = c$の等値面を描画することで，初期状態と異なる状態を表せることを示した．これは，$f(\boldsymbol{x}) = g(\boldsymbol{x}) - c$と置くことで，任意の状態を陰関数曲面$f(\boldsymbol{x}) = 0$として表せることを意味する．発泡金属には，Closed-cellとOpen-cellの中間体も存在するが，本方法ではcの値を調整することで様々なレベルの中間体を表すことができ，多様な状態を表現可能となった．

キーワード：発泡金属，オープンセル，クローズドセル，中間状態，陰関数，自動形状モデリング

Journal（掲載誌）
Journal of Advanced Simulation in Science and Engineering, Vol. 8, No. 1, pp. 143-153, Jun. 2021.

Ayumi TAKAHASHI

Assistant Professor, Department of Mathematical Information Engineering

Ayumi Takahashi is an Assistant Professor at the Department of Mathematical Information Engineering, College of Industrial Technology, Nihon University. He received his BEng, MEng, and PhD degrees in 2008, 2010, and 2013, respectively, all from Nihon University. He worked as a Research Assistant from 2013 to 2016 and as an Assistant Professor from 2016 to 2024. His research topics include vibration analysis, acoustic analysis, and musculoskeletal analysis. Dr. Takahashi received the Best Paper Award at the 7th Thai Society of Mechanical Engineers International Conference in 2016. He is a member of the Japan Society of Mechanical Engineers and the Society of Automotive Engineers of Japan.

Research Achievements

1) Quantification of Ride Comfort Using Musculoskeletal Mathematical Model Considering Vehicle Behavior, Computer Modeling in Engineering & Sciences, 3(135) 2287-2306, Nov, 2022.
2) Prediction of Biot Parameters for Fibrous Sound Absorbing Materials, Transactions of Society of Automotive Engineers of Japan, 49(4) 787-792, Jul, 2018.
3) Using a musculoskeletal mathematical model to analyze fatigue of the muscles in the lower limbs during different motions, Computer Modeling in Engineering and Sciences, 114(2) 191-207, 2018.
4) Optimization of Nonlinear Vibration Characteristics for Seismic Isolation Rubber, Computer Modeling in Engineering & Sciences, 113(1) 1-15, Nov, 2017.

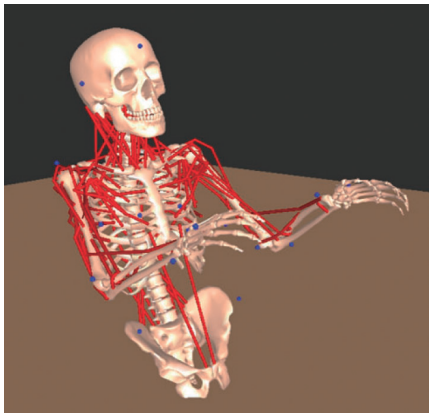


Fig. 1 Musculoskeletal model

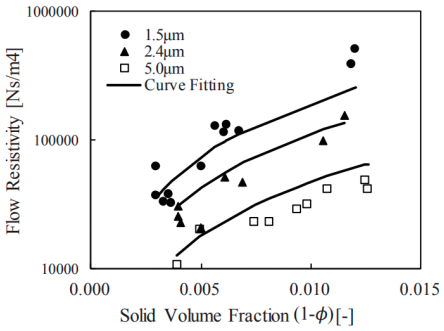


Fig. 2 Curve fitting of flow resistivity with solid volume fraction

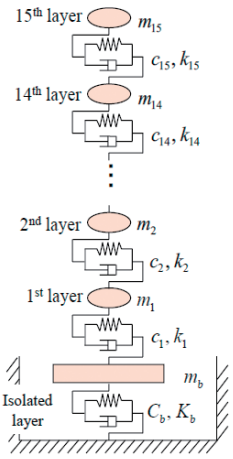


Fig. 3 Schematic diagram of high-rise building structure

Published Paper

Quantification of ride comfort using musculoskeletal mathematical model considering vehicle behavior

Junya Tanehashi, Szuchi Chang, Takahiro Hirosei, Masaki Izawa, Aman Goyal, Ayumi Takahashi and Kazuhito Misaji

This research aims to quantify driver ride comfort due to changes in damper characteristics between comfort mode and sport mode, considering the vehicle's inertial behavior. The comfort of riding in an automobile has been evaluated in recent years on the basis of a subjective sensory evaluation given by the driver. However, reflecting driving sensations in design work to improve ride comfort is abstract in nature and difficult to express theoretically. Therefore, we evaluated the human body's effects while driving scientifically by quantifying the driver's behavior while operating the steering wheel and the behavior of the automobile while in motion using physical quantities. To this end, we collected driver and vehicle data using a motion capture system and vehicle CAN and IMU sensors. We also constructed a three-dimensional musculoskeletal mathematical model to simulate driver movements and calculate the power and amount of energy per unit of time used for driving the joints and muscles of the human body. Here, we used comfort mode and sport mode to compare damper characteristics in terms of hardness. In comfort mode, damper characteristics are soft and steering stability is mild, but vibration from the road is not easily transmitted to the driver making for a lighter load on the driver. In sport mode, on the other hand, damper characteristics are hard and steering stability is comparatively better. Still, vibration from the road is easily transmitted to the driver, which makes it easy for a load to be placed on the driver. As a result of this comparison, it was found that a load was most likely to be applied to the driver's neck. This result in relation to the neck joint could therefore be treated as an objective measure for quantifying ride comfort.

Keywords : Biomechanics, driver's sense of fatigue, double lane change, musculoskeletal mathematical model.

車両挙動を考慮した筋骨格数理モデルによる乗り心地の定量化

本研究は，車両の慣性挙動を考慮し，コンフォートモードとスポーツモードにおけるダンパー特性の変化によるドライバーの乗り心地を定量化することを目的とする．近年，自動車の乗り心地は，運転者の主観的な官能評価に基づいて評価されている．しかし，乗り心地を向上させるために運転感覚を設計に反映させることは抽象的であり，理論的に表現することが難しい．そこで，ドライバーのハンドル操作時の挙動や走行中の自動車の挙動を物理量で定量化することで，運転時の人体影響を評価した．モーションキャプチャシステムと車両のCANセンサ，IMUセンサを用いて，ドライバーと車両のデータを収集した．また，3次元筋骨格数理モデルを構築し，ドライバーの動きをシミュレートするとともに，人体の関節や筋肉の駆動に使用されるパワーや単位時間あたりのエネルギー量を算出した．ここでは，コンフォートモードとスポーツモードを使い，ダンパー特性を比較した．コンフォートモードでは，ダンパー特性はソフトで操縦安定性はマイルドだが，路面からの振動がドライバーに伝わりにくく，ドライバーへの負担が軽い．一方，スポーツモードはダンパー特性が硬く，操縦安定性は比較的良い．それでも，路面からの振動はドライバーに伝わりやすく，ドライバーへの負荷がかかりやすい．この比較の結果，ドライバーの首に荷重がかかりやすいことがわかった．したがって，この頸部関節に関する結果は，乗り心地を数値化するための客観的な指標として扱うことができた．

キーワード：バイオメカニクス，ドライバーの疲労，ダブルレーンチェンジ，筋骨格数理モデル

Journal（掲載誌）
Computer Modeling in Engineering & Sciences, 3(135) 2287-2306, Nov, 2022

Shigeki FURUKAWA

Professor, Department of Sustainable Engineering

Shigeki Furukawa is a Professor at the Department of Sustainable Engineering, College of Industrial Technology, Nihon University. He worked as an Assistant at the Department of Industrial Chemistry, Faculty of Industrial Engineering, Nihon University in 1986, as a Research Assistant, College of Industrial Engineering, Nihon University in 1990, and Full-time Lecturer, College of Industrial Engineering, Nihon University in 1993. In August 2001, he was dispatched to the USA as a long-term overseas researcher for one year to conduct research on coal liquefaction catalysts at Nihon University. In 2006, he received his Engineering Doctorate from Nihon University for studies on the hydrocracking of coal pretreated with chromic anhydride. In 2009, he transferred to the Department of Sustainable Engineering, College of Industrial Technology, Nihon University. He worked as an Associate Professor at the Faculty of Industrial Engineering, Nihon University in 2010 and as a Professor at the Faculty of Industrial Engineering, Nihon University in 2014. His specialties are resource chemistry and process engineering. His research themes are the development of biodiesel fuel (BDF) synthesis processes, CO_2 adsorption and separation, and resource recycling. He is a member of the Chemical Society of Japan, the Japan Institute of Energy, the Japan Petroleum Institute, and the Japan Society of Sea Water Science.

Research Achievements

1) Naoki Toyama, Tatsuya Takahashi, Norifumi Terui and Shigeki Furukawa, Synthesis of Polystyrene@ TiO_2 Core–Shell Particles and Their Photocatalytic Activity for the Decomposition of Methylene Blue, *Inorganics* **2023**, 11, 343.

2) Shigeki Furukawa, Kensuke Otokawa, Osamu Sasaki, Ken Nakayasu, and Tatsuaki Yamaguchi, Regioselective Direct Carboxylation of 2-Naphthol with Supercritical CO_2 in the Presence of K_2CO_3, Int. *J. Org. Chem*., **2013**(3), 210-213

3) Shigeki Furukawa, Yoshihiro Uehara, and Hiroshi Yamasaki, Variables affecting the reactivity of acid- catalyzed transesterification of vegetable oil with methanol, *Bioresource Technology*, **101**, 2010, 3325-3332

4) Masaki Okada, Tomoo Nakane, Shigeki Furukawa, Kaoru Onoe, Toshihiko Hiaki, Effect of Sound Wave Irradiation on Methane Conversion in DC Pluse Discharge Plasma, *Chemical Product and Process Modeling*, **4**, 2009, 1-10

Main research activities in our laboratory

- Synthesis of MOFs with azobenzene and/or stilbene dicarboxylic acid as ligands and evaluation of their CO_2 adsorption and desorption properties (below Illustration)
- Investigation of the preparation conditions for bamboo charcoal for the purpose of refining waste cooking oil
- Investigation of preparation conditions for bamboo charcoal for the purpose of regulating humidity in indoor spaces

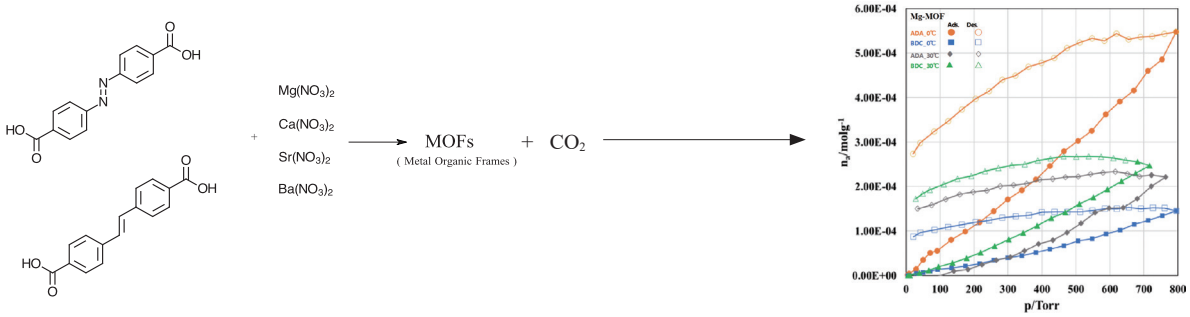


Illustration Synthesis of MOFs and CO_2 adsorption/desorption isotherms for MOFs.

Published Paper

Variables affecting the reactivity of acid-catalyzed transesterification of vegetable oil with methanol

Shigeki Furukawa, Yoshihiro Uehara, Hiroshi Yamasaki

In this paper, the dominant factors affecting the reactivity of acid-catalyzed transesterification of vegetable oil with methanol have been investigated. Effects of varying the acid catalyst species, surface active agent type and content were studied. Also, the effect of the type of oil was examined. Biodiesel fuel yields increased with the addition of sodium dodecylsulfonate as surface active agent because the mass transfer rates of protons and methanol to the oil phase through the oil–methanol interface were increased with increasing interfacial area. Evaluation of the reaction kinetics, based on changes in parent oils containing triglyceride or diglyceride showed that the activation energies were almost no change, but the frequency factors were 2210 and 9827 mol/min, respectively. Therefore, it was concluded that a lower reactivity during acid-catalyzed transesterification with methanol was caused by a lower contact probability for oil, methanol and acid catalyst in the presence of an oil–methanol interface during the reaction.

Keywords: Acid-catalyzed transesterification, Biodiesel fuel, Surface active agent, Emulsion

植物油とメタノールの酸触媒によるエステル交換反応の反応性に影響

本論文では、植物油の酸触媒によるメタノールを用いたトランスエステル化反応の反応性に影響を与える主な要因について調査した。酸触媒の種類の違い、界面活性剤の種類および含有量の変化による影響が調査された。また、油の種類による影響も調査された。バイオディーゼル燃料の収率は、界面活性剤としてドデシル硫酸ナトリウムを添加することで増加した。これは、油相へのプロトンとメタノールの質量移動速度が、界面積の増加に伴って増加したためである。トリグリセリドまたはジグリセリドを含む親油の変化に基づく反応速度評価により、活性化エネルギーはほとんど変化しないが、頻度因子はそれぞれ2210および9827 mol/minであることが示された。したがって、メタノールを用いた酸触媒によるエステル交換反応の反応性が低いのは、反応中に油とメタノールと酸触媒の接触確率が低いことが原因であると結論付けられた。

キーワード：酸触媒エステル交換反応，バイオディーゼル燃料，界面活性剤，エマルション

Journal（掲載誌）
Bioresource Technology, 101, (2010), 3325–3332

Takeshi TAKEMURA

Professor, Department of Sustainable Engineering

Takeshi Takemura is a Professor at the Department of Sustainable Engineering, College of Industrial Technology, Nihon University. He received his PhD in Engineering from Saitama University in 2005, after which he began his research activities at the Department of Architectural, Civil and Environmental Engineering, School of Science and Engineering, Tokyo Denki University. In 2013, he moved to Nihon University and expanded his research interests to the relationship between water and the environment, including rivers, lakes, wetlands, and coastal areas, and is now particularly interested in flow structures and plant interactions, and the assessment of riparian environments. Dr. Takemura also spent four months, from June to September 2018, as a visiting scholar at the Bren School of Environmental Science and Management, University of California, Santa Barbara. He is a member of the Japan Society of Civil Engineering (JSCE), the Ecology and Civil Engineering Society (ECES), the Japan Society of Fluid Mechanics (JSFM), the Japanese Society of Limnology, and the International Association for Hydro-Environment Engineering and Research (IAHR).

Research Achievements

1) Takeshi TAKEMURA, Shinya NISHIO, Tomoaki NAKAMURA: Fundamental Study on Monitoring Microplastic Deposition in Sanbanze Using UAV, 40th International Association for Hydro-Environment Engineering and Research (IAHR) World Congress, 2023.8.

2) Shinnosuke KAMEI, Takuya HASEGAWA, Shu YIN, Takeshi TAKEMURA, Shigeki FURUKAWA and Masakazu MATSUMOTO : Investigation of the Properties of Hard Clam (Mercenaria mercenaria) Shells as a Source of Calcium-based Materials, Salt and Seawater Science & Technology, Vol. 3, pp.58-62, 2023.2.

3) Takeshi TAKEMURA, Yuki UCHIDA, Tomoaki NAKAMURA, Hirokazu SUMI, Akira ODA, Minoru OCHIAI : Fundamental study on estimation method of vegetated area of Ulva spp. by using NDVI, XXXVIII International Association for Hydro-Environment Engineering and Research (IAHR) World Congress, 2019.9.

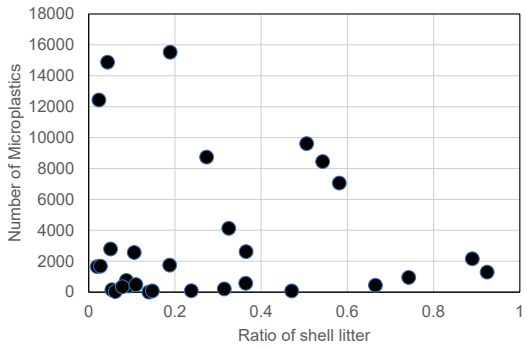


Figure 1 Relation between the ratio of shell litter and number of microplastics

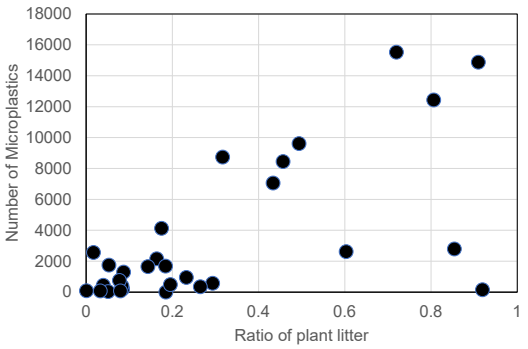


Figure 2 Relation between the ratio of plant litter and number of microplastics

Published Paper

Fundamental Study on Monitoring Microplastic Deposition in Sanbanze Using UAV

Takeshi TAKEMURA, Shinya NISHIO and Tomoaki NAKAMURA

The Sanbanze, located in the northernmost part of Tokyo Bay, has a large amount of debris, most of which is shells and plant litter, and not many large visible plastic debris. However, microplastics are thought to have drifted and accumulated in Sanbanze as well. In this study, we conducted a field survey to understand the accumulation of microplastics in the Sanbanze using images taken by an unmanned aerial vehicle (UAV). The results of the spectral reflectance characteristics of all the litter in Sanbanze showed that the reflectance was lowest at 430 nm and increased with increasing wavelength. In the case of 100% shell litter, the reflectance was greater than the other litter at all wavelengths. On the other hand, the reflectance of 100% plant litter was generally lower. These results indicate that the reflectance of shell litter is generally greater than that of plant litter and sand, and that the reflectance of plant litter is less than that of sand up to a wavelength of 800 nm, after which the reflectance of dead plant litter is greater. Based on these results, we investigated the identification of litter floating ashore using NDVI calculated from UAV images. As a result, differences were observed between the case of shell litter and the case of plant litter. In the case of this study, the NDVI value ranged from 0.13 to 0.32 for plant litter detection and from 0 to 0.12 for shell litter detection.

Keywords : Microplastics, UAV, NDVI, Sanbanze

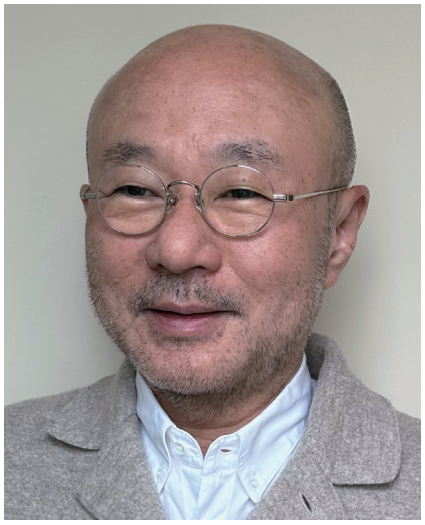
三番瀬における UAV 画像を用いたマイクロプラスチック堆積状況把握に関する基礎的検討

東京湾最奥部に位置する三番瀬には，貝殻や植物由来のゴミが多く，大きなプラスチックゴミはそれほど確認できない．しかし，近年の沿岸域におけるマイクロプラスチック（以下MPs）による汚染の状況を踏まえると，三番瀬においてもMPsが漂着・堆積していると推測される．そこで，本研究では三番瀬におけるMPsの蓄積状況を把握するために，無人航空機（UAV）による撮影画像を用いた現地調査を実施した．三番瀬で確認された漂着ゴミに関して分光反射率特性を調べた結果，反射率は430nmで最も低く，波長が長くなるにつれて高くなることが確認された．さらに，貝殻ゴミ100％場合，他のゴミに比べて全ての波長域で反射率が大きくなった．一方，植物ゴミ100％の場合，反射率は小さくなった．これらの結果より，貝殻ゴミの反射率は一般に，植物ゴミや砂の反射率よりも大きくなる．他方，植物ゴミの反射率は波長800nmまでは砂の反射率よりも小さく，それ以降は植物ゴミの反射率が大きくなることがわかった．これらの結果を踏まえ，UAVで撮影した画像から算出したNDVIを用いて漂着物の同定を検討した．その結果，貝殻ゴミを対象とした場合と植物ゴミを対象とした場合で違いが見られた．本研究で検討した範囲では，植物ゴミを検出する場合のNDVI値は0.13～0.32，貝殻ゴミを検出する場合のNDVI値は0～0.12であった．

Journal（掲載誌）
Proceedings of the 40th IAHR World Congress, Aug. 2023

Mamoru TANAKA

Associate Professor, Department of Conceptual Design



Mamoru Tanaka is an Associate Professor at the Department of Conceptual Design, College of Industrial Technology, Nihon University. He received his Master of Fine Arts degree in Interior Design from the Savannah College of Art and Design, USA in 1992 for his thesis "Integrating Culturally Appropriate Design Features into Residential Design," and his Doctoral degree in Design from Kobe Design University in 2008 for his thesis "A Study of Installation Techniques of Artistic Elements to Public Space." Prior to his academic career as an Associate Professor, he accumulated substantial practical experience in the fields of architectural and interior design, working for both an architectural design firm and an interior design company. He is currently a member of several professional associations, including the Architectural Institute of Japan, the Japanese Society for the Science of Design, and the Art Society of Shinseisaku. As a member artist of the Art Society of Shinseisaku, he exhibits his design works at the National Art Center, Tokyo every September. Besides his regular teaching duties at the university, he participates in industry-academia collaborative projects. One such project involved collaborating with students to design and create window displays for Benjamin Moore Japan Co., Ltd., an American paint company situated in Aoyama, Tokyo. It was a great way for students to experience the real-world demands of design.

Research Achievements

1) Title of the design work "Lole, A Discarded T-shirt" was showcased at "the Upcycling Art Exhibition – For the Future," which was held as part of the "Second Japan International Art Festival" to coincide with the 2025 World Expo in Osaka, 2024.10.17 - 2024.10.24
As a guest artist, I had the honor of presenting my experimental design work at this exhibition.

2) Window Display Work "White Winter" (25th Industry-academia Collaboration Project Between Benjamin Moore Japan Co., Ltd. and Mamoru Tanaka Laboratory), 2023.12.2 - 2025.12.25
This window display installation, titled "White Winter" was a collaborative project between academia and industry and featured at the Benjamin Moore Aoyama Flagship Store.

3) Featured in the 2015 Public Group Best Selection Art Exhibition, title of the selected work "the world in the twelve - 2," the Tokyo Metropolitan Art Museum Press, p.111
This design work was exhibited at the 78th Shinseisaku Exhibition held at the National Art Center, Tokyo in September 2014, and was subsequently selected for the 2015 Public Group Best Selection Art Exhibition.

Works and Exhibitions

1) Left: Design Work "Lole, A Discarded T-shirt" at the upcycled art exhibition
Right: Exhibition poster

2) Window Display Work "White Winter"

3) Left: the selected work "the world in the twelve - 2"
Right: Exhibition poster

Work Introduction

Exploring the role of design in creating a sustainable future

Mamoru TANAKA

It is often said that our standard of living has improved with economic growth. After World War II, many European engineers immigrated to the United States. In the 1950s and 1960s, the United States, under these circumstances, had abundant resources but a shortage of engineers. Therefore, to increase production, they developed mechanized industries based on the principle of "planned obsolescence." The idea of planned obsolescence spread to the design industry, leading to shorter product lifespans and increased consumer spending. "Planned obsolescence" is a strategy designed to encourage consumers to discard their possessions and purchase new products. In essence, it is a planned culture of disposability.

In response to this social situation, this research aimed to design objects with new purposes by recycling and upcycling discarded items such as things that are broken or no longer used, or out-of-fashion clothing. As part of his research, I was invited to exhibit an experimental design work at "the Upcycling Art Exhibition – For the Future," which will be held as part of the "Second Japan International Art Festival" to coincide with the 2025 World Expo in Osaka. My invitation to this exhibition is due to my collaboration with a company engaged in innovative research on recycling clothing into paper products. The exhibition was held at the Kennin-ji Temple, Main Guest Hall in Kyoto from October 17 to 24, 2024, followed by a tour of Osaka University of Economics, Kyushu Sangyo University, and the Orie Art Gallery (Tokyo).

Keywords : Sustainable design, eco-design, upcycle, recycled material, education

デザインを通してサスティナブルな社会を目指す方法の研究

経済発展と共に生活は豊かになっていると言われている。第二次世界大戦後、多くのヨーロッパの技術者達がアメリカに亡命した。この社会状況下の50年代～60年代のアメリカは、資源はあるが技術者の少ない時代であった。そのため、「計画的廃物化」の原理で生産高の増大のために機械化産業を発達させた。計画的廃物化の考え方はデザイン業界に広がり、製品の寿命が短くなり、消費者の支出が増加した。この「計画的廃物化」とは、新しく作った物を買ってもらうために、持っている物をどんどん捨ててもらう「使い捨て文化の計画」である。

上記の社会情勢に対し、本研究では捨てる物（使用しなくなった物、壊れた物、着なくなった服など）をリサイクルやアップサイクルし新しい目的を持たせた物をデザインすることを目的としている。研究の一環として田中遵は、2025年日本国際博覧会を契機に開催する「第２回　日本国際芸術祭」の一環として開催される「アップサイクルアート展　-未来のために-」に招待作家として実験作品を出展した。この展覧会へ招待されたのは、田中遵が洋服を紙などにリサイクルする実験をしている企業と提携しているからである。展覧会は2024年10月17日から10月24日にかけて京都の建仁寺･大書院で開催され、この会期後は、大阪経済大学、九州産業大学、オリエアートギャラリー（東京都）にて巡回展も行った。

キーワード：サスティナブルデザイン，エコデザイン，アップサイクル , 廃材，教育

Exhibition（展示）

Title of the design work "Lole, A Discarded T-shirt" was showcased at "the Upcycling Art Exhibition – For the Future" at the Kennin-ji Temple, Main Guest Hall in Kyoto from October 17 to 24, 2024. After being exhibited at the Kennin-ji Temple, Main Guest Hall, the design work will travel to Osaka University of Economics, then Kyushu Sangyo University, and finally the Orie Art Gallery in Tokyo.

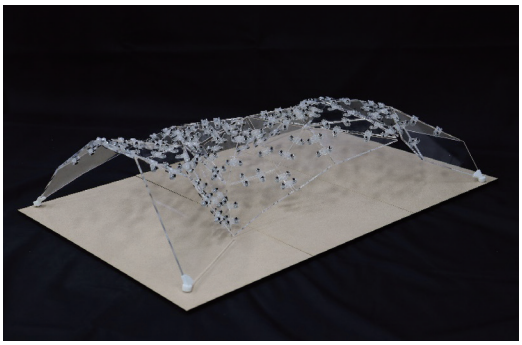
Kentaro HAYAKAWA

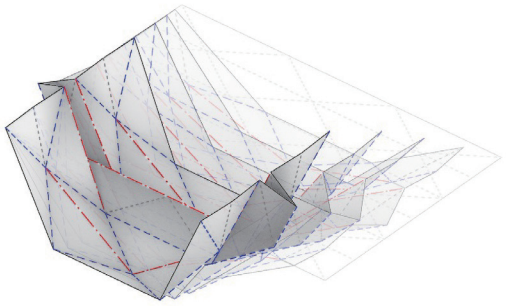
Research Assistant, Department of Conceptual Design

Kentaro Hayakawa is a Research Assistant at the Department of Conceptual Design, College of Industrial Technology, Nihon University. He received his BEng degree in 2018, MEng degree in 2020, and EngD degree in 2023, all from Kyoto University. His doctoral thesis was "Design and Geometrically Nonlinear Analysis of Rigid Origami Structure with Multiple Degrees of Freedom." He worked in the Department of Architecture and Architectural Engineering, Graduate School of Engineering, Kyoto University from April 2023 to March 2024 as a program-specific Assistant Professor. From 2024 to the present, he has been working at Nihon University. His research focuses on the engineering application of origami and other mechanisms that can change their overall shape without deformation of the structural members. In particular, he works on form generation for rigid origami, development of numerical models for rigid folding mechanisms, and analysis of infinitesimal and finite mechanisms. In addition, he works on finding geometric forms of architectural curved surfaces for shell and membrane structures that harmonize efficiency, low cost, and aesthetics while guaranteeing security and safety. He is a member of AIJ, JSIAM, IASS, and ISSMO.

Research Achievements

1) Kentaro Hayakawa and Makoto Ohsaki, Form generation of rigid origami for approximation of a curved surface based on mechanical property of partially rigid frames, International Journal of Solids and Structures, 216, 182-199, May 2021
2) Kentaro Hayakawa, Zeyuan He, Simon D. Guest, Panel-point model for rigidity and flexibility analysis of rigid origami, Computational Geometry, 121, 102100, Apr 2024
3) Kentaro Hayakawa and Tomotaka Ohba and Makoto Ohsaki, Analytical and numerical investigation of second-order infinitesimal mechanism in rigid origami, Mechanism and Machine Theory, 194, 105572, Apr 2024
4) Kentaro Hayakawa, Makoto Ohsaki, and Jingyao Zhang, Meshless non-parametric shape design of piecewise approximately developable surfaces using discretized local Gauss map, Journal of the International Association for Shell and Spatial Structures, 65(1), 5-14, Mar 2024
5) Kentaro Hayakawa, and Makoto Ohsaki, Panel-pin model for kinematic and equilibrium analysis of rigid origami, Journal of the International Association for Shell and Spatial Structures, 64(4), 278–288, Dec 2023





Published Paper

Form generation of rigid origami for approximation of a curved surface based on mechanical property of partially rigid frames

Kentaro HAYAKAWA and Makoto OHSAKI

A method is presented for approximating a curved surface by a developable rigid origami; a polyhedral shape which can be developed to a plane without deformation of its facets. Form generation starts from a triangulated surface, and an optimization problem is solved to obtain a polyhedron which satisfies the geometric conditions for developability. The degrees of freedom of a rigid origami mechanism with only triangular facets are often too large for the engineering application, and therefore, it is sequentially reduced by fixing (removing) some crease lines, along which the rigid facets rotate. However, the crease line that is not fixed often becomes unable to rotate in the process of fixing the crease lines; consequently, the polyhedron cannot be developed to a plane. To avoid such an unfavorable locking situation, selection criteria of the crease line to be fixed are proposed. They are defined based on the eigenvalues and their derivatives of the stiffness matrix of the frame model, which is the numerical model for form generation and mechanism analysis of rigid origami. The performance of the proposed criteria is demonstrated through the examples of surfaces with some patterns of crease lines.

Keywords : Rigid origami, Form generation, Optimization, Deformation mechanism, Partially rigid frame

曲面近似のための部分剛接合骨組の力学的特性にもとづく剛体折紙の形状生成法

平面展開可能な剛体折紙で曲面を近似する方法を提案する。平面展開可能な剛体折紙とは，面を変形させることなく接続状態を保って平面に展開できる多面体形状のことである。形状生成は三角形面のみからなる多面体形状を初期形状とし，最適化問題を解くことで平面展開可能であるための幾何学的条件を満たす多面体形状を得る。三角形面のみからなる剛体折紙の変形自由度は工学的応用には大きすぎる場合が多いため，隣り合う面の折線まわりでの相対回転を順次固定（折線を除去）することにより，変形自由度を小さくしていく。しかし，折線を固定する過程で，固定されていない折線までもが回転できなくなり，その結果，多面体を平面に展開することができなくなる場合がしばしばある。このような折線がロックした好ましくない状態を避けるため，固定する折線の選択基準を提案する。提案基準は，剛体折紙の形状生成と変形メカニズムの解析のための数理モデルであるフレームモデルの剛性行列の固有値とその微分係数にもとづいて定義される。いくつかの折線パターンにおける形状生成例をとおして，提案基準の有効性を示す。

キーワード：剛体折紙，形状生成，最適化，変形メカニズム，部分剛接合骨組

Journal（掲載誌）
International Journal of Solids and Structures, 216, 182-199, May 2021

Masako IWADATE

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Masako Iwadate is an Associate Professor at the Department of Liberal Arts and Basic Sciences, College of Industrial Technology, Nihon University. She received her BPhEd degree in 2000, followed by her MEd degree in 2002, and her PhD in Education in 2005, all from Nihon University. She was employed at the Research Institute of Physical Fitness of the Japan Women's College of Physical Education from 2005 to 2007, after which she joined Nihon University. Her primary area of research is neuroscience. Recently, she has been investigating the neurovisceral integration model via functional near-infrared spectroscopy (fNIRS) and heart rate variability (HRV). Additionally, she is a certified yoga instructor at the studio Yoggy and has initiated scientific research into the advantages of traditional yoga techniques. She is a member of the Japanese Society for Health and Behavioral Sciences, the Japanese Society for Exercise and Sports Physiology, and the Japanese Society for Yoga Therapy.

Research Achievements

1) Effects of yogic breathing 'Kapalabhati' on dorsolateral prefrontal cortex and cardiac autonomic activity in yoga inexperienced persons, Health and Behavior Sciences17(2), 59-66, 2019.
2) Effects of yogic breathing 'Kapalabhati' on hemodynamics of yoga beginners, Health and Behavior Sciences15(1), 13-19, 2016.
3) Relationship between forearm muscle oxygenation and cognitive performance during preparation for the Stroop task, Health and Behavior Sciences13(2), 43-50, 2015.
4) Preparatory change of Forearm muscle oxygenation for Execution of Maximal exercise, Journal of College of Industrial Technology Nihon University,47 17-24, 2014.
5) Relationship between the sensorimotor cortex and increased heart rate during preparation for maximal voluntary handgrip exercise: An NIRS study, Health and Behavior Sciences11(2), 91-98, 2013.

Published Paper

Effects of yogic breathing ‘Kapalabhati’ on dorsolateral prefrontal cortex and cardiac autonomic activity in yoga inexperienced persons

Masako IWADATE, Kazuki YANAGISAWA and Hitoshi TSUNASHIMA

We examined the relationship between the activity of the dorsolateral prefrontal cortex (DLPFC) and heart rate variability (HRV)component after practice of yogic breathing ‘Kapalabhati’ (KB) with a tempo of 0.16, 0.25, and 0.5 Hz for yoga inexperienced persons. We concomitantly measured the tissue oxygen index (TOI) using near-infrared spectroscopy in the forehead and the vagal (high frequency; HF) component of HRV during a resting period, KB period, and recovery period. We observed no difference between the TOI of the right and left brains of the KB period at any tempo. In the comparison between the resting period and the recovery period, TOI of the right DLPFC significantly decreased in the recovery period compared to the rest period only in the 0.25 Hz tempo. Furthermore, a significant positive correlation was found between the difference in recovery period from resting period in both the right TOI and the HF component of HRV in the 0.25 Hz tempo. From this result, it was suggested that practice of KB with 0.25 Hz tempo for 1 minute by yoga inexperienced persons reduced the right DLPFC activity, and which was related with cardiac parasympathetic nerve activity.

Keywords : brain oxygenation, dorsolateral prefrontal cortex, high frequency yoga breathing, heart rate variability, yoga inexperienced persons

ヨーガ未経験者におけるカパーラバティ呼吸が背外側前頭前野の皮質活動および心臓自律神経活動に及ぼす影響

本研究では、ヨーガ未経験者を対象に、0.16、0.25および0.5Hzのカパーラバティ呼吸法（KB）実施直後の背外側前頭前野皮質（DLPFC）および心拍変動（HRV）成分の関連を調べた。安静期、KB期および回復期において、近赤外分光法による脳組織酸素指数（TOI）とHRVの各成分を同時に記録した。その結果、KB期においては、いずれのテンポでも、右脳と左脳において、コントロール課題との間に差はみられなかった。安静期と回復期との比較において、右DLPFCのTOIは、回復期において、0.25Hzのテンポにおいてのみ有意に低下した。さらに、0.25Hzのテンポにおける、HRVのHF成分と右DLPFCのTOIについて、安静期に対する回復期の差について、有意な正の相関がみられた。この結果から、ヨーガ未経験者が0.25Hzで1分間KBを行うと、右DLPFCの活動低下が生じ、それと比例して心臓副交感神経活動も低下するという連動性が示された。

キーワード : 脳酸素動態，背外側前頭前野皮質，高頻度ヨーガ呼吸法，心拍変動成分，ヨーガ未経験者

Journal（掲載誌）
Health and Behavior Sciences, Vol. 17, No. 2, 59-66, 2019 (in Japanese)

Kentarou MORI

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Kentarou Mori is an Assistant Professor at the Department of Liberal Arts and Basic Sciences, College of Industrial Technology, Nihon University. He received his BEng degree in Materials and Applied Chemistry from Nihon University in 2008, and his PhD from Nihon University in 2013. From 2013 to 2014, Dr. Mori worked at Nihon University as a Postdoctoral Researcher. While working at the Graduate School of Science and Technology, his major research topic was inorganic material chemistry, especially the development of new red emitting afterglow phosphors. He is a member of the Society of Inorganic Materials, Japan, the Ceramic Society of Japan, and the Rare Earth Society of Japan.

Research Achievements

1) Novel White Emitting Phosphors Composed of Two Types of Strontium Aluminate and Europium Ions Obtained in a Single Synthesis, Journal of the Society of Inorganic Materials, Japan, Vol.31, No.429, 69-76, Mar 2024.

2) Influence of Eu Ions on White Light Emission of Strontium Aluminate, Salt and Seawater Science & Technology, Vol.3, 35-36, Nov 2022.

3) Synthesis and Fluorescence Studies of Eu^{3+}-doped $SrAl_{12}O_{19}$ Phosphor, Optik, Vol.180, 183-188, Feb 2019.

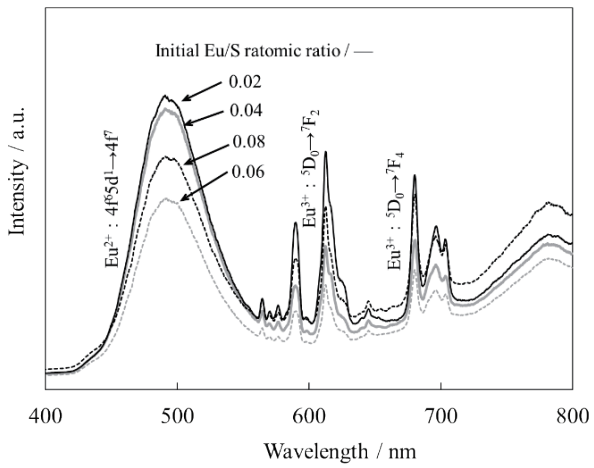

Fig.1 Effect of initial Eu/Sr atomic ratio on emission spectra of phosphors.

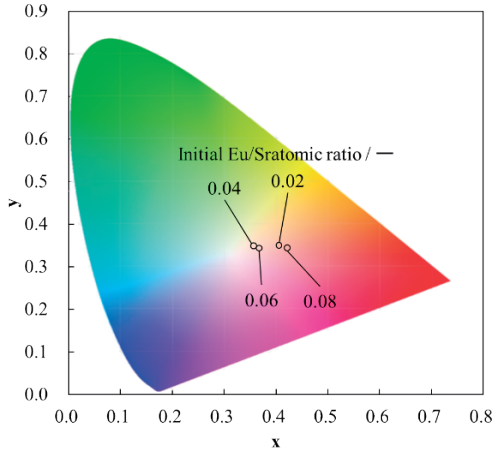

Fig.2 CIE chromaticity diagram for phosphors with different initial Eu/Sr atomic ratio.

Published Paper

Novel White Emitting Phosphors Composed of Two Types of Strontium Aluminates and Europium Ions Obtained in a Single Synthesis

Kentarou MORI, Naoki OSAKA, Takeshi TOYAMA and Yoshiyuki KOJIMA

In order to obtain a phosphor that emits white light with high color rendering, an attempt was made to synthesize a phosphor based on strontium aluminate as a matrix crystal. The phosphors were obtained by calcination in air, without using any reducing agents. Synthesis in an air atmosphere resulted in fluorescent materials based on a mixed phase of $SrAl_{12}O_{19}$ and $Sr_4Al_{14}O_{25}$. Irradiating the mixture with an excitation wavelength of 365 nm produced red luminescence derived from Eu^{3+} ions and blue-green luminescence derived from Eu^{2+} ions. The reason why the emission of Eu^{2+} ions was observed is thought to be due to the reduction reaction of Eu^{3+} ions activated in $Sr_4Al_{14}O_{25}$ in the matrix crystal by calcination in an air atmosphere. As the synthesis conditions changed, the ratio of each produced compound changed, and the luminescence color changed accordingly. The chromaticity coordinates (0.357,0.348) were obtained as the chromaticity coordinates closest to the white point. The synthesis conditions were a calcination temperature of 1400 ℃ and an initial Eu/Sr atomic ratio of 0.04. The present study suggests that several strontium aluminate-based phosphors can be synthesized simultaneously by a single synthetic method, and their luminescence color can be made close to the white point.

Keywords : Phosphor, white emission, Eu ion, strontium aluminate, luminescence

一度の合成で得られた 2 種類のアルミン酸ストロンチウムとユウロピウムイオンからなる新規白色発光蛍光体

本研究の目的として演色性の高い白色発光する蛍光体を得るため，アルミン酸ストロンチウムを母体結晶とする蛍光体の合成が試みられた．蛍光体は還元剤などを使用せず，空気中での焼成で得られた．空気雰囲気下での合成の結果，$SrAl_{12}O_{19}$と$Sr_4Al_{14}O_{25}$の混合相による蛍光材料が得られた．混合物に励起波長365nmを照射することで，Eu^{3+}イオンに由来する赤色発光とEu^{2+}イオンに由来する青緑発光が得られた．Eu^{2+}イオンからの発光が確認できた理由は，$Sr_4Al_{14}O_{25}$内に付活されたEu^{3+}イオンが空気雰囲気下での焼成により，母体結晶内での還元反応が生じたためと考えられる．合成条件の変化に伴い，各化合物の生成する割合が変化し，それに伴い発光色も変化した．最も白色点に近い色度座標として(0.357,0.348)が得られた．その合成条件は，焼成温度1400℃で初期Eu/Sr原子比0.04の条件であった．本研究より，１つの合成方法で，複数のアルミン酸ストロンチウムを母体材料とする蛍光体の同時合成が可能で，さらにその発光色を白色点に近いものとすることが可能であることが示唆された．

キーワード：蛍光体，白色発光，Eu イオン，アルミン酸ストロンチウム，発光

Journal（掲載誌）
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