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ASIA ANALYSIS

P.30 | TECHNOLOGICAL ADVANCES IN IRRIGATION TECHNIQUES

Aarthi Janakiraman, Research Director at TechVision, Frost & Sullivan, explores technological advances in irrigation techniques that aid in preserving crop yield and quality in drought-prone areas

The International Longevity Centre is the UK's leading authority on the impact of healthy ageing. Here, the ILC's **Emily Evans** explains how research can enable Japan's citizens to live longer in good health and what others can learn from this

Open Access Government examines some aspects of science and technology policy in Japan, including cooperation and research promotion

Shaw-Ruey Lyu, Professor from Dalin Tzu-Chi Hospital, Tzu-Chi University, says that the knee health promotion option and cell therapy are a perfect combination for knee osteoarthritis

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Editor's Introduction

Welcome to Asia Analysis's Autumn edition, where you'll find an impressive collection of expertly written and policy-oriented editorials and academic profiles.

Suppose you're looking for something to do while sipping on a hot cup of coffee. In that case, you might want to start reading about technological advances in irrigation techniques that assist with preserving crop yield and quality in drought-prone areas. Climate change is a cause for alarm, and its effects on agriculture are far-reaching, writes Aarthi Janakiraman, Research Director, TechVision at Frost & Sullivan.

Are you aware that the International Longevity Centre (ILC) is the UK's top expert on the impact of healthy ageing? Emily Evans from the ILC explains how research can help Japanese people live longer and healthier lives and what other countries can learn from it. It's up to others to try and reverse the ageing process. Still, ILC is focused on evidence-based research on healthy ageing to create policy solutions so everyone can reap longevity's benefits.

It is gratifying to receive constructive comments from individuals at the Jockey Club Centre for Positive Ageing regarding reducing restraint measures in Hong Kong care home settings. This esteemed organisation's research highlights essential components such as staff training, environmental design changes, and regular case conferences as practical tools to significantly reduce restrictions amongst care home residents.

Open Access Government also provides information about some aspects of Japanese science & technology policy, with analysis covering everything from science and technology collaboration to research promotion, ICT research and cutting-edge medical technologies.

On that thrilling note, I hope you'll join us for more in-depth volumes of this valuable publication in 2024 and beyond.

Jonathan Miles
Managing Editor

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How research can help Japan move the needle toward healthy ageing

The International Longevity Centre is the UK's leading authority on the impact of healthy ageing. Here, the ILC's Emily Evans explains how research can enable Japan's citizens to live longer in good health and what others can learn from this

In the world of ageing research, significant funds are being invested, some with the tantalising promise of immortality. However, the International Longevity Centre UK leaves any attempts to reverse the ageing process to others and focuses on conducting evidence-based research into healthy ageing to pioneer policy solutions so everyone can realise the benefits of longevity.

The ILC-UK was founded by Baroness Sally Greengross in 1997 after she was inspired by Robert Butler in the US and Shigeo Morioka in Japan, who established the first ILCs in 1990. Together, the three were instrumental in setting up the ILC Global Alliance – now encompassing 16 organisations globally, with the aim of helping societies navigate the challenges of population ageing and reap the opportunities of longevity.

Ageing populations

A lot has changed since the 1990s. Globally, the population has surged from 5.3 billion to over 8 billion. However, the annual growth rate has dwindled from 1.77% to 0.88%. Japan stands out, having one of the most rapidly ageing populations, with a median age exceeding 48.5 years. To provide perspective, the UK's median age is 39, China's 37.9, and India's 27.6.

While people around the world are living longer, this does not necessarily mean healthier lives. The ILC's Healthy Ageing and Prevention Index ranks 121 countries against six indicators: life span, health span, work span, income, environmental performance, and happiness. Japan clinches the top position for life expectancy (84.3 years) and healthy life expectancy, averaging 74.1 years.

Yet, its ranking is pulled down to 17th due to other metrics. This indicates a need for policymakers to delve deeper, as healthy ageing is not merely about longevity but the quality of those additional years.

Japan's universal health coverage

Japan's health system is characterized by a universal insurance scheme allowing individuals to select their preferred clinics or hospitals. There is currently minimal primary or community care in Japan and no system of general practitioners (GPs). Instead, people head straight to a specialist operating at a clinic.

However, there is growing apprehension about the system's sustainability due to escalating medical costs from an ageing populace and stagnated economic growth. In 2015, Japan recognised that to keep its population healthy and productive for longer, there was an urgent need to rebuild a sustainable healthcare system that could better respond to demographic change.

A paradigm shift to a new system was proposed in the report Japan Vision: Health Care 2035 with the goal "to build a sustainable, responsive and equitable system that delivers better health outcomes for all". And to move Japan's health system from "inputs to outcomes, from quantity to quality and efficiency, from cure to care, and from specialization to integrated approaches across all sectors". [1]

Japan's approach to dementia

In Japan, over 4.6 million people are living with dementia, with the total expected to soar to about 7.3 million people – or one in five Japanese aged 65 or over – by 2025. In 2019, Japan launched a new national strategy aiming to ensure people can live well with dementia. The strategy was co-produced with people with dementia and their families and promotes co-existence and prevention.

Japan's approach to dementia, which involves the fusing of data, technology, and interactive human care, makes the country an interesting pioneer. But while ahead of other countries in many respects, Japan can still learn lessons from elsewhere. For example, ongoing research by the Alzheimer's Society-funded PriDem project led by Newcastle University in the UK and co-produced with people living with dementia, suggests shifting the coordination of care from secondary to primary care services. This results in more personalised and timely post-diagnostic support, which could be up to 40% cheaper than specialist care. [2]

Moving the needle on immunisation in Japan

Beyond access to clean water and sanitation, immunisation is the most effective way to prevent dozens of life-changing diseases. Yet, for a wealthy and ageing country, Japan remains an outlier in terms of attitudes to adult vaccination. Pre-COVID surveys show that just 4.7% of adults in Japan felt that vaccines were important, 25.1% agreed they were safe, and 9.9% felt they were effective.

Despite grappling with a flu epidemic in 2019, Japan is still struggling to significantly raise vaccination uptake rates among people aged 65 and over. However, the juxtaposition of COVID-19 and the rescheduled Tokyo Olympics presented new opportunities to increase vaccination uptake in Japan.

In 2022, the ILC-UK and Stripe Partners tackled the question of vaccine hesitancy by conducting ethnographic research and face-to-face interviews with older adults and health professionals in urban and rural Japan to better understand the barriers to vaccination. These barriers included practical obstacles, a lack of awareness, a failure to take vaccine-preventable diseases seriously and vaccine hesitancy. To address these issues, the Moving the Needle report presents innovative blueprints, including targeted communication strategies, testing local vaccine events, and overhauling the vaccine booking system.

Conclusion

While older Japanese citizens are proactive about their health and independence, a more strategic, holistic, and adaptable evidence-based approach to health policy in Japan will be crucial in ensuring healthier and more productive longer lives.

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REDUCING RESTRAINT ON RESIDENTS IN HONG KONG CARE HOME SETTINGS

Individuals from the Jockey Club Centre for Positive Ageing discuss reducing using restraint on residents in Hong Kong care home settings

Restraint use among residents in care home settings could be significantly reduced by implementing a multi-component restraint reduction programme, a research study conducted by Jockey Club Centre for Positive Ageing (JCCPA) said. [1]

The study involved the implementation of a comprehensive programme over 12 months. The programme included staff training, examination of current care practices, environmental design modifications, monthly case conferences, and support from multidisciplinary experts.

Implemented in two care homes, the programme demonstrated a significant 30% reduction in restraints. One of the primary reasons for employing restraints, fall prevention from chairs, was also significantly reduced following the implementation of the restraint reduction programme.

Restraint on residents in Hong Kong care home settings

It is a common practice to employ physical devices, such as geriatric tables, safety vests, mitts, and lean-back chairs, to restrict the movement of individuals in various care settings. In Hong Kong, safety vests and seat belts are commonly used as restraints in local care homes, followed by mitts and limb holders. The global prevalence of physical restraint varies widely, ranges from 15% to 85% [1-3], depending on the definition used.

Hong Kong experiences the same phenomenon, and physical restraint is claimed to be the most common form of elderly abuse in local care settings. Unfortunately, the situation is deteriorating. A longitudinal study indicated that restraints in Hong Kong increased by 40% over ten years, from 52.7% in 2005 to 74.2% in 2015. [4]

The authors attributed the increasing trend to several factors, including the growth of the elderly population, a rising number of individuals with impaired cognitive function, and an increase in individuals with limited self-care abilities and mobility being enrolled in care home settings.

Individuals with dementia have more chance of being restrained, and the severity of dementia correlates with the use of physical restraints. A study revealed that approximately 60% of residents with dementia living in nursing homes were found to be restrained, primarily during nighttime, often with up to five different types of restraints. [5] This vulnerable group requires particular attention when addressing the issue of physical restraint.

The main reason for employing restraints on residents in care home settings is to protect them from falls and related injuries. Residents with a history of previous falls or fractures are more likely to be subjected to restraint. A research study showed that four-fifths of the residents in nursing homes were restrained to prevent falls and related injuries. [6]

Managing challenging behaviour is another common reason for the use of restraints. Both physical and verbal aggressive behaviours, such as throwing objects or shouting at staff, have been found to correlate with the use of physical restraints. [7]

Restraints are often claimed to be used to protect the safety of residents, staff, and others involved. Other reasons for their use include compensating for the shortage of healthcare workers, facilitating treatment, and assisting with performing personal care. [2,8,9]

The impact of restraint

Both temporary and prolonged restraint can lead to negative physical and psychological outcomes. The use of restraints deprives residents of the ability to exercise, which can result in a loss of muscle strength and endurance, decreased mobility, and increased incontinence. [10]

Restraints can impair blood circulation in the restrained body part, leading to blood stasis and affecting the nerves. [1] Other common symptoms of prolonged immobility include contractures and pressure ulcers. [5]

Contradicting the intended purpose of preventing falls and related injuries, restraints can exacerbate the risk of

falls and expose individuals to injuries, such as suffocation when attempting to escape from safety vests, and, in severe cases, even death.

Restrained residents in care home settings often experience a low quality of life. Their rights are disregarded, and they feel humiliated and uncertain about the reasons for being restrained. [6] The loss of social interaction and disorientation further exacerbate cognitive decline, devastating for individuals with dementia.

Challenging behaviour may escalate when the movement of the residents is prohibited, despite it being one of the main reasons for using restraints. Research has demonstrated that restraints can lead to negative emotions such as agitation, frustration, anxiety, and depression. [11] This creates a vicious cycle, perpetuating the detrimental impact on the individual's well-being.

Interventions to reduce restraint

Various interventions have been developed over the past decades to reduce restraint use. Multi-component programmes incorporating staff training on knowledge and attitudes regarding restraint reduction and consultation have proven effective in lowering restraint use in different countries worldwide.

Since healthcare workers are typically involved in the decision-making and application of restraints, their education, attitudes, and opinions regarding restraint use greatly influence their willingness to reduce its use.

Comprehensive training programmes, encompassing theoretical and practical aspects, can equip healthcare workers with the necessary knowledge and confidence to reduce restraint use effectively. Previous applications of multi-component restraint reduction programmes in hospital wards in Hong Kong have yielded positive results [4,12], indicating the feasibility of implementing such programmes in the local setting.

The widespread use of physical restraints in care home settings, including Hong Kong, raises concerns about the well-being of residents and emphasises the urgent need for effective interventions. The detrimental effects of physical and psychological restraint use underscore the importance of finding alternative approaches to ensure the safety and dignity of individuals in care home settings.

Multi-component restraint reduction programmes

The research study conducted by JCCPA highlights the potential of multi-component restraint reduction programmes, which incorporate key elements such as staff training, environmental design modifications, and regular case conferences to reduce restraints among care home residents significantly.

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KNEE HEALTH PROMOTION AND CELL THERAPY FOR KNEE OSTEOARTHRITIS

Shaw-Ruey Lyu, Professor from Dalin Tzu-Chi Hospital, Tzu-Chi University, says that the knee health promotion option and cell therapy are a perfect combination for knee osteoarthritis

Knee osteoarthritis background

Knee osteoarthritis (knee OA) is commonly but mistakenly referred to as a degenerative process of the knee. The mainstream medical community has devoted uncounted resources and talents to identifying the cause of knee OA, but that effort has only produced controversial results.

Consequently, sufferers of knee OA have not been able to rest, and the deteriorating course of knee OA symptoms, which typically start from stage I and worsen to stages II, III, IV, and V, puts the patients through increasingly agonising pain and discomfort.

The mainstream medical community collectively has tried to offer relief to their knee OA patients, such as nonpharmacological interventions, systemic drug treatment, intra-articular therapies ranging from corticosteroids to hyaluronans to more recently platelet-rich plasma, and more invasive surgical procedures such as arthroscopy or corrective osteotomy.

These treatments are the best they offer after spending billions of dollars on R&D over the decades, but these treatments have been repeatedly shown to be sorely inadequate. Many patients eventually require knee replacements, which are permanent but far from ideal.

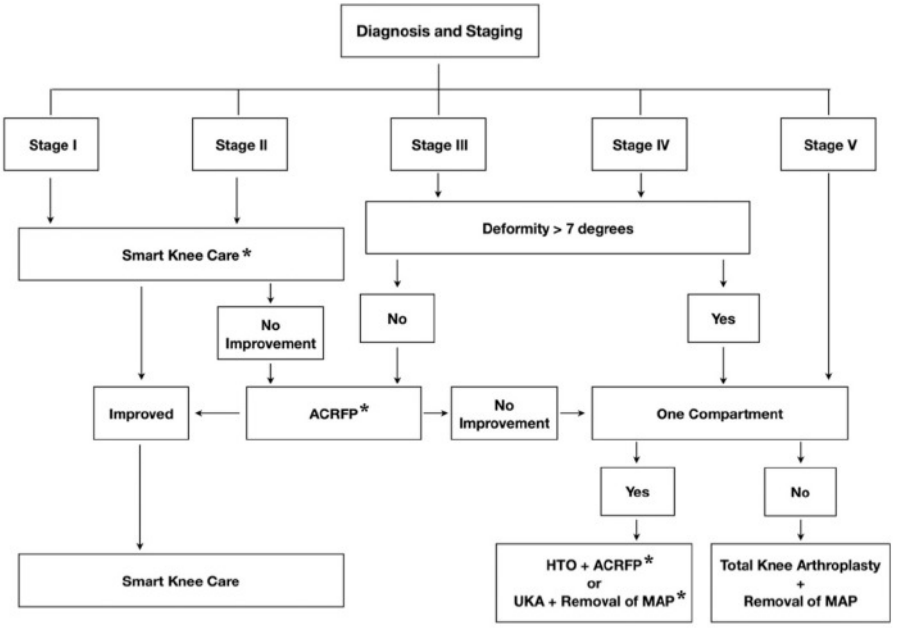

Figure 1. The KHPO Protocol

*** When cell therapy could be an add-on**

ACRFP: Arthroscopic Cartilage Regeneration Facilitating Procedure; HTO: High Tibial Osteotomy; UKA: Unicompartmental Knee Arthroplasty; MAP: Medial Abrasion Phenomenon

Improved treatment: KHPO

Once a mainstream orthopaedic surgeon, I am now an advocate for improved treatment of knee OA based on my discovery of a neglected cause of knee OA, the Medial Abrasion Phenomenon (MAP). [1]

My treatment differs from the mainstream treatment in two significant aspects: the Lyu treatment 1.) aims at diminishing the MAP while the mainstream treatment does not, and 2.) is less invasive. Over 15,000 patients have benefited from our treatment protocol, the Knee Health Promotion Option or KHPO (Figure 1). [2]

Following the KHPO protocol and a special surgical technique, Arthroscopic Cartilage Regeneration Facilitating Procedure (ACRFP) [3], patients no longer need pain medications or other mainstream treatments for relief.

Their knee OA no longer deteriorates. They live their everyday lives again, and most will not need knee replacement. Many patients have seen their damaged knee cartilage regenerated (think thickened). We have seen case after case of cartilage regeneration in our knee OA patients whom we treated under the KHPO protocol – without the assistance of cell therapy [3-5].

Cell therapy and knee health promotion

Adipose-derived stem cells (ADSCs) are stem cells that are found in fat tissues. They are a good source of adult mesenchymal stem cells that can be obtained through surgery (such as arthroscopy) and then separated, cultured, and proliferated using special techniques.

Stem cells are highly modulable and self-renewing and can repair damaged tissues or organs. They are also an autologous, readily available source and pose low rejection risks.

Stem cells possess four major characteristics: they can regenerate and repair, have immunomodulatory effects, differentiate into multiple cell types, and have low immunogenicity. ADSCs treat osteoarthritis in the following ways.

Stem cells inside the joint can be recruited and aggregated. They secrete various anti-inflammatory cytokines to reduce inflammation and pain. They also slow down and prevent cartilage destruction while promoting cartilage regeneration. After injecting ADSCs into the joint, significant cartilage regeneration can be observed in six months.

KHPO/Cell therapy combination

KHPO alone has brought about cartilage repair and regeneration in about 80% of patients after ACRFP [3-5], but we strive for even better results. We added cell therapy to the KHPO treatment protocol to further boost knee cartilage regeneration.

Generally, we will diagnose and assess whether the patient is a good candidate for cell therapy. If so, adipose stem cell samples are acquired, isolated, cultivated, and stored.

The final step is the injection of the ADSCs into the knee joint. Cell therapy could be an add-on for stages I-II patients when doing smart knee care. For patients receiving ACRFP, adipose tissue could be obtained during ACRFP. The timeline of this stem cell therapy process dovetails very nicely with the timeline of recovery of a typical KHPO-treated patient, making the KHPO/cell therapy a perfect combination for treating knee OA.

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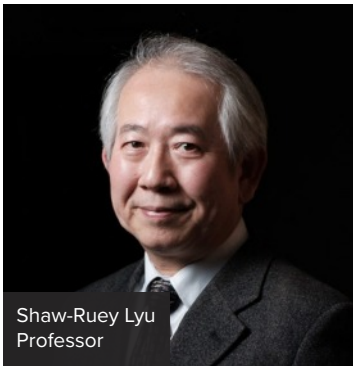

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Japan: Science and technology policy

Open Access Government examines some aspects of science and technology policy in Japan, including cooperation and research promotion

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The Science and Technology Basic Plan in Japan, based on the Science and Technology Basic Law, was implemented in November 1995. The basic plan aims to implement science and technology (S&T) policies comprehensively and systematically. The Basic Plan is formulated based on the forecasting of the next decade, and the policies are implemented over a five-year timespan. [1]

An earlier version of Open Access Government reported that in 2020, the Basic Law was amended for the first time in 25 years and changed its name to the Science, Technology, and Innovation Basic Law. The 6th Basic Plan, which covers the fiscal years 2021 to 2025, was the first developed after the amendment. [2]

MEXT S&T policies

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) believes Japan must be at the forefront of science and technology to remain competitive globally and build a strong society and economy. [5] Minister of Education, Culture, Sports, Science and Technology MORIYAMA Masahito has headed up the Ministerial team at MEXT since September 2023.[3] Before this, the role was taken by NAGAOKA Keiko, commencing in August 2022. [4]

Japan's S&T governance functions per the fundamental Council for Science and Technology Policy CSTP policies under the Prime Minister's leadership. MEXT coordinates with related ministries to develop and implement basic policies related to S&T policy. MEXT also produces and implements specific plans related to promotion and Research and Development (R&D) and liaises with related government agencies to promote S&T. [5]

Science and technology cooperation

In addition, fostering collaboration between industry, academia, and government is necessary to ensure that university research results are disseminated to the public and revitalise university higher education and research. MEXT strives to foster a more collaborative relationship between industry, academia and government. It seeks to place coordinators to foster an environment where universities can participate in this cooperation on their own terms.

MEXT also helps universities and businesses collaborate on research and use the results of their study in practical ways and offers expert advice on intellectual property and technology transfer. [6]

Research promotion

MEXT believes that science and research are the keys to creating new fields of knowledge, driving innovation, and helping spread the knowledge that we all share. In a nutshell, MEXT supports academic research in universities and inter-university research institutions to create new knowledge based on innovative concepts, aiming to secure fundamental funding that supports academic research.

MEXT also encourages big-scale international research projects to develop the infrastructure needed for

research by setting up research centres worldwide, but, of course, fundamental research also contributes to the nation's social and economic growth by driving innovation. [7]

Information Science and technology research

Information science and technology, including cutting-edge computing technologies, data analytics technologies and network technologies, are essential for success in various domains and are crucial for Society 5.0. The goal of Society 5.0 is to achieve a balance between economic growth and the resolution of social issues through the integration of digital and physical space.

AI, in particular, has become popular due to advances in hardware to process large amounts of data and advances in machine learning, including deep learning. R&D on AI is growing globally. MEXT supports R&D and social applications of AI technologies by providing comprehensive support for R&D on innovative basic technologies, with the RIKEN Center for Advanced Intelligence Project (AIP Center) as the focal point, and funding formidable research themes.

MEXT contributes to the advancement of scientific research by constructing a High-Performance Computing Infrastructure (HPCI), where supercomputers at multiple national universities and research institutions are connected through the Science Information Network (SINet6) and provide computing resources in response to user requirements. [8]

Cutting-edge medical technologies

It's only fitting to mention that Japan's Ministry of Health, Labour and Welfare (MHLW) developed the "Strategy of SAKIGAKE"; indeed, their Ministry Project Team will take the world to the next level in the real-world application of cutting-edge medical technologies.

This Strategy consists of two dimensions, ranging from fundamental research to clinical research/trials, as well as approval reviews, safety protocols, insurance coverage, the enhancement of infrastructure and the conditions for corporate activities, and global expansion.

On the one hand, the SAKIGAKE Designation System supports R&D in Japan with the goal of early practical application of new pharmaceuticals, medical devices and regenerative medicinal products. On the other hand, the Scheme for Rapid Authorization of Unapproved Drugs aims to speed up the use of unapproved or off-label drugs for serious or life-threatening illnesses.

It expands the scope of the Council on Unapproved Drugs/Off-label Use to include drugs not approved in Western countries as long as they meet specific criteria and by improving the conditions for companies to develop such drugs. [9]

Japan's Science and Technology (S&T)

This comprehensive article has examined how MEXT supports R&D and promotes S&T cooperation, research promotion, and information S&T and cutting-edge medical technologies. We extend our sincerest congratulations to the Minister of Education, Culture, Sports, Science and Technology as he promotes S&T. Several aspects of R&D have been discussed, with a brief interlude to consider an element of this from the view of Japan's Ministry of Health, Labour and Welfare. [10]

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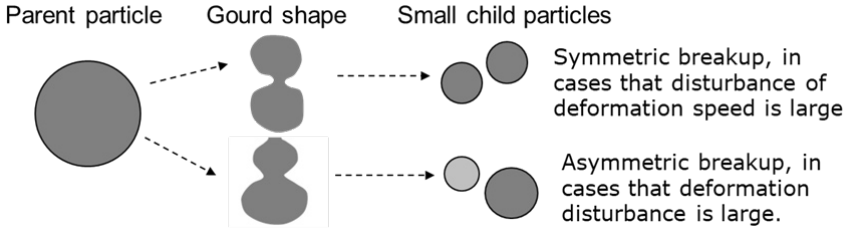
INTERDISCIPLINARY RESEARCH ON THE SPLITTING PROCESSES OF VARIOUS PARTICLES

Professor Ken Naitoh from the Department of Applied Mechanics and Aerospace Engineering at Waseda University in Japan, walks us through universal laws discovered from outstanding integrated interdisciplinary research on the splitting processes of various particles

This profile will discuss universal patterns revealed by particle breakups research, particularly interdisciplinary connections. This discussion will include hyper-gourd theory for producing quantum leaps of subatomic, biological, cerebral, economic, cosmic, and information worlds, leading to a carbon-zero society, third universal medication, and easy earth-space drive.



The inevitability of particular masses for various biological and abiological flexible particles lying from subatomic to cosmic levels is synthetically revealed as the scales fall from the eyes. This is possible because each "flexible" particle is commonly generated by a mode in which a larger particle mainly breaks up into two smaller ones through a "gourd" shape with two lumps while showing left-right symmetrical and asymmetrical divisions.

Essentially, rather than "hyper-string", "hyper-gourd" relatively explains the inevitability of particular particle masses well because the rate-determining stage is basically around breakup timing with a gourd shape having two smooth particles connected. Particles include hadrons, quarks, leptons, atoms, biological molecules hydrated, liquid droplets of fossil fuel and water, living cells including microorganisms and cancers, multi-cellar systems such as organs, neural systems and the brain, stars, galaxies, and the cosmos.

These particular masses, sizes, frequencies, and diversity of particles dominated by the super-magic numbers, in fractal nature, can be derived by the dynamic model based on quantum-statistical fluid mechanics of the flexible fluid-like gourd (Hyper-gourd theory).

As particles are larger than molecules, biological cells include lots of clearly visible water. This is because, for example, living beings can survive with water of about 70% as the main components. In contrast, gourds of molecules are hydrated, and subatomic particles may be related to gluon and quark condensation-like immersed mass. Thus, we found that water decides masses of five types of nitrogenous bases, i.e., masses of purine and pyrimidine.

Examining actual particle masses quantitatively

Let us examine some actual particle masses quantitatively. The dynamic model approximated for force terms by using the first order Taylor expansion and the weakest stability principle shows us that particular masse ratios of various particles have a fusion of about symmetric 1:1 of Yamato ratio and weak left-light asymmetric 2:3, where close to golden-silver ratios are inevitably observed in nucleic acids, IgXs, and also organs.

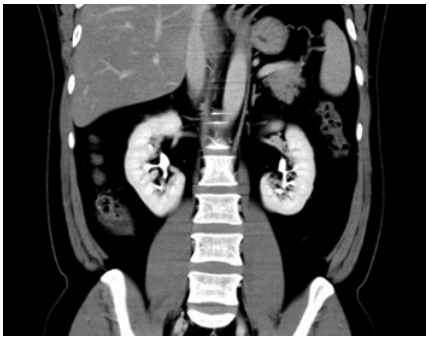
Typical examples are Watson-Crick base pairs in DNA of about 2:3, while left-right asymmetric lungs or liver are about 2:3 parts. In contrast, living beings have some symmetric base pairs in RNA and symmetric urine, arms, legs, eyes, and nose. (Liver has asymmetric left and right leaves.) The dynamic model reveals its inevitability.

More on the dynamical model

The inevitable fusion of two types, i.e., asymmetry and symmetry, clarified by further analyses based on the dynamic model, also reveals the essential mechanism of producing three-dimensional structures through self-organising from one-dimensional DNA information in living beings. This

can easily be understood because two connection types of blocks (2:3 and 1:1) give children more shapes of three-dimensional objects with functions like grasping.

Consequently, this model clarifies the physical relation between one-dimensional information, three-dimensional complex structure with concave and convex, and function (Onto-biology). This may also lead to a new medical approach to Situs inversus.



It should be emphasised that, according to speeds of neutron colliding, abiological uranium 235 symmetrically and asymmetrically breaks up into child particles of about 2:3 and 1:1, i.e., the two patterns with symmetric breakup due to high-speed neutron impact and asymmetric one for low energy input. This also answers the question of which is the predominant, symmetric or asymmetric part, according to characteristics of disturbances entering from the outer area.

Thus, this also brings the possibility of a new engine reactor related to low-energy nuclear reaction without radiation (Fusine: fusion engine), essentially overcoming the global warming problem and free travel to space, resulting in peace. The Fusine will result in human beings fighting only in outer areas far from the Earth in the next century.

By applying the 9th order of Taylor expansion, this dynamical model also qualitatively reveals the larger asymmetric mass ratios over 1:3 for amino acids and proteins and huge mass ratios over 10,000:1 for tiny elementary particles such as hadrons, quarks, and leptons. Thus, analyses based on the dynamical model bring a new definition of the boundary between living beings and non-living systems.

The dynamic model based on gourds lying between quantum, statistical, and continuum mechanics posits a new hyper-interdisciplinary physics that explains an extensive range of scales, concentrating only on breakup timings. At the same time, the Newton, Schroedinger, and Boltzmann equations describe only a narrow range of scales.

Moreover, it is apparent that the fusion of molecular particles' symmetric and asymmetric mass ratios naturally leads to various reaction paths between the particles, which are symmetric and asymmetric parts inside molecular network patterns employed in multi-cellar systems, including human beings.

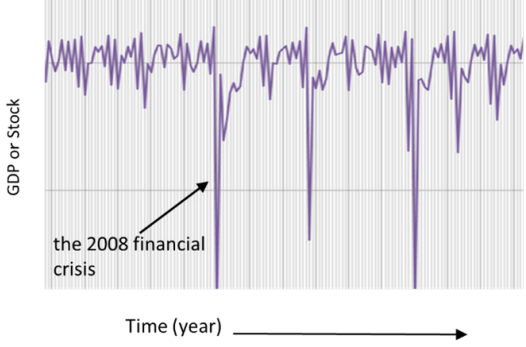
A macroscopic kinetic equation model for the networks of six variables (Prognostic medication and Morphogenic economics)

After logically classifying all the known and unknown molecules into six macroscopic molecular groups (three information groups and three function groups), we derived a macroscopic kinetic equation model for the six variables. Then, the kinetic equation model for the fusion of symmetric and asymmetric network patterns reveals fundamental biological clock and illness history, including catastrophic situations such as cancer and manic depression.

This shows the possibility of predicting the premonition of severe illnesses in humans and animals (Prognostic medication). This may generate new biotechnology as the third panacea after intravenous drip (water injection) and IPS cells.

Emphasis is also placed on the kinetic model for predicting severe illness of individual human beings, which may also predict economic catastrophes like panic (Morphogenic economics). This is because biological cells inside the human body mathematically and macroscopically correspond to companies filled with the human beings in the world and because the economic world of an aggregate of human beings is also said to be alive.

The amount of CO_2 emissions from each company will be roughly proportional to the total sales of the company. Thus, this kinetic model will clarify which group among the six company groups produces much CO_2. Six company groups are three information groups (active group related to deep information, active one



Morphogenic economics
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related to weak information, and depressive one) and three function groups related to three information groups. Thus, this may clarify the best way to reduce CO_2 and lead to a peaceful world while reducing economic disparity.

Beyond artificial intelligence

Beyond artificial intelligence, like the methodology for predicting the premonition of illness, we also propose artificial genius because the parts in network patterns of sizes of the golden-silver ratios around 2:3 also led to sympathy with outer information, including the ratios of about 2:3, i.e., a comfortable feeling for the human brain. This comfort implies polestar for conception.

There is also recent experimental evidence by other researchers that supports the relationship between the asymmetric neural system and comfort. One of the first targets of my laboratory is the automatic production of comfort and hilarious music, not a mixture of traditional music and songs, i.e., leading to more love and peaceful minds.

Fugine: Future ultimate efficiency engine

About thirty years ago, one of the starting points of my work was on the thermo-fluid dynamic models of breakup processes of liquid fuel droplets in traditional compressive combustion engines, including stratified-charge reaction. It is well known that more breakups of liquid fuel particles result in higher thermal efficiency, higher combustion efficiency, and less emissions such as NOx, soot, and unburned hydrocarbon (HC).

Thus, finally, I should stress that the dynamic model shown here also produces the other quantum leap of combustion engines, which may bring very high thermal efficiency close to that of the Carnot cycle due to nearly complete air insulation leading to less heat loss on chamber walls and relatively silent high compression leading to less exhaust gas temperature.

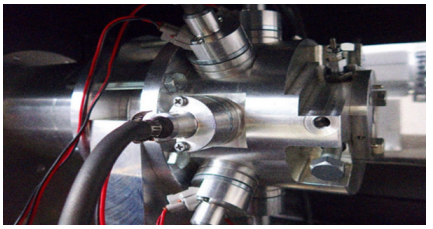
This engine (Fugine: future ultimate efficiency engine) is very cheap for everyone and suitable for hydrogen fuel. Nissan sells a strong hybrid engine vehicle (HEV) now after a pure battery electric vehicle (BEV), while Mitsubishi sells plug-in HEV (PHEV). Toyota sells HEV and PHEV.

The other European automotive companies will mainly sell PHEVs after BEV because PHEV may use about only a quarter of e-fuel compared with the engine-only system. This is also because PHEV can supply electricity for houses in two ways, when stronger hurricanes increasing cut power transmission lines more frequently from now. For these purposes, Fugine will be the critical technology.

Automobiles bring us actual chances of connections of lovers like a gourd, although the internet leads to only initial weak approaches of people like two particles before attaching. Hyper-gourd, viewed from subatomic to cosmic levels, is one of the keywords for everything.

About 15 years ago, a new fluid-dynamic method for solving a 50-year mystery was also proposed by my laboratory, which can simulate and predict mysterious turbulent flow for internal flows like those in engines, which has not been solved for over 50 years. The method strongly also accelerates the development of Fugine.

Turbulence is an aggregate of various sizes of vortices. We can see galaxies over heaven, which also have vortex structures. Thus, this method may



reveal cosmic mysteries in the future. Therefore, we can see the universe in the engine and propose engine-verseology.

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FOSTERING FUNDAMENTAL COMPUTATIONAL SKILLS, A GLOBAL CHALLENGE

Koji Watanabe, Professor from Miyazaki International University in Japan, argues that fostering fundamental computational skills is a global challenge

The international community recognises cultivating fundamental computational skills as a critical challenge in achieving the Sustainable Development Goals (SDGs) by 2030. The mathematics education of a country plays a crucial role in fostering these basic computational skills. Therefore, a comprehensive approach that considers various components of school education (educational goals, teachers, teaching materials, and children) is necessary. Additionally, the concept of quantity in developing basic computational skills is context-dependent and requires attention.

The study seeks to address the challenges the international community poses regarding mathematics education. We strive to gain a detailed understanding of the current situation and develop teaching materials and educational practices based on this understanding.
Our specific focus is on cultivating basic computational skills in developing countries.

We aim to assess the actual state of basic computational skills, including the concept of quantity among children, and develop effective teaching materials and educational practices to elucidate their effects.

Computational abilities of children in developing countries

Research on the actual computational abilities of children in developing countries is still in its early stages and has a long way to go. There needs to be more research that reveals the true extent of mathematical proficiency among children in developing countries. The overall picture of low academic achievement is depicted in various international assessments (such as PISA and TIMSS), but the delineation between what students cannot and can do needs to be clarified.

Furthermore, there is a need for more teachers who are well-versed in mathematics. While some educators might deepen their knowledge of instructional techniques for mathematics, a significant number still need a fundamental understanding of the subject. This highlights the perceived need for opportunities and resources to enhance teachers' own mathematical learning.

The significance of quantitative literacy

For instance, let us consider three apples and three dogs. Disregarding

the distinction between apples and dogs, the common element of 'three' is focused on. Through this abstraction, the concept of 'three' is extracted.

In this abstraction, we move beyond concrete items like apples and dogs and recognise a semi-concrete entity encompassing their commonality. This leads to the abstract concept of the number 'three'. Notably, the instances of 'three' within the context of scenes involving apples and dogs represent a form of quantity. This quantity is discrete and can be counted.

However, mathematical education goes beyond discrete quantities and involves continuous quantities like length and area. These specific contexts enable learning about rational numbers, equations, and calculations. Understanding the concept of 'quantity' is essential for learning elementary arithmetic. Therefore, it is crucial to emphasise the perspective of 'quantity' through instructional materials and methodologies.

A case study in Zambia

In Zambia, many children approach simple calculations like 8+7 or 15-9 differently. Instead of using methods like column addition or subtraction, they draw eight sticks and then add seven more sticks, to represent the number and count them to find the total.

Therefore, they often do not leverage the structure of the decimal positional numeral system. Because counting is the prevalent calculation strategy, acquiring decimals and mastering fraction calculations will likely be challenging. Mastery of the positional numeral system, fundamental for calculations, seems to be a prerequisite before delving into computations involving fractions.

The inherent challenges of measuring academic performance

Assessing children's abilities and comprehension can be challenging. Combining quantitative and qualitative methods is used to understand their skills comprehensively. In the quantitative realm, test construction uses test theories like item response and classical test theories to measure computational ability.

Additionally, interviews take place to capture the thought processes involved. Moreover, an analysis of the country's mathematics curriculum and textbooks is necessary to enhance the validity of these investigations.

Collaborative research fosters many viewpoints, enabling the integration of insights from various regions, cultures, and educational systems. This enriched perspective enhances our understanding of the complexities of mathematics education globally. By acknowledging and respecting the diversity of approaches and challenges, collaborative research has led to more effective strategies and solutions that can uplift mathematics education globally.

Establishing ongoing feedback loops between researchers and educators facilitates the refinement and adaptation of strategies over time. This iterative process can result in more contextually relevant and impactful interventions. The synergy between research and practical applications is crucial in addressing low academic achievement and paving the way for tangible improvements in mathematics education.

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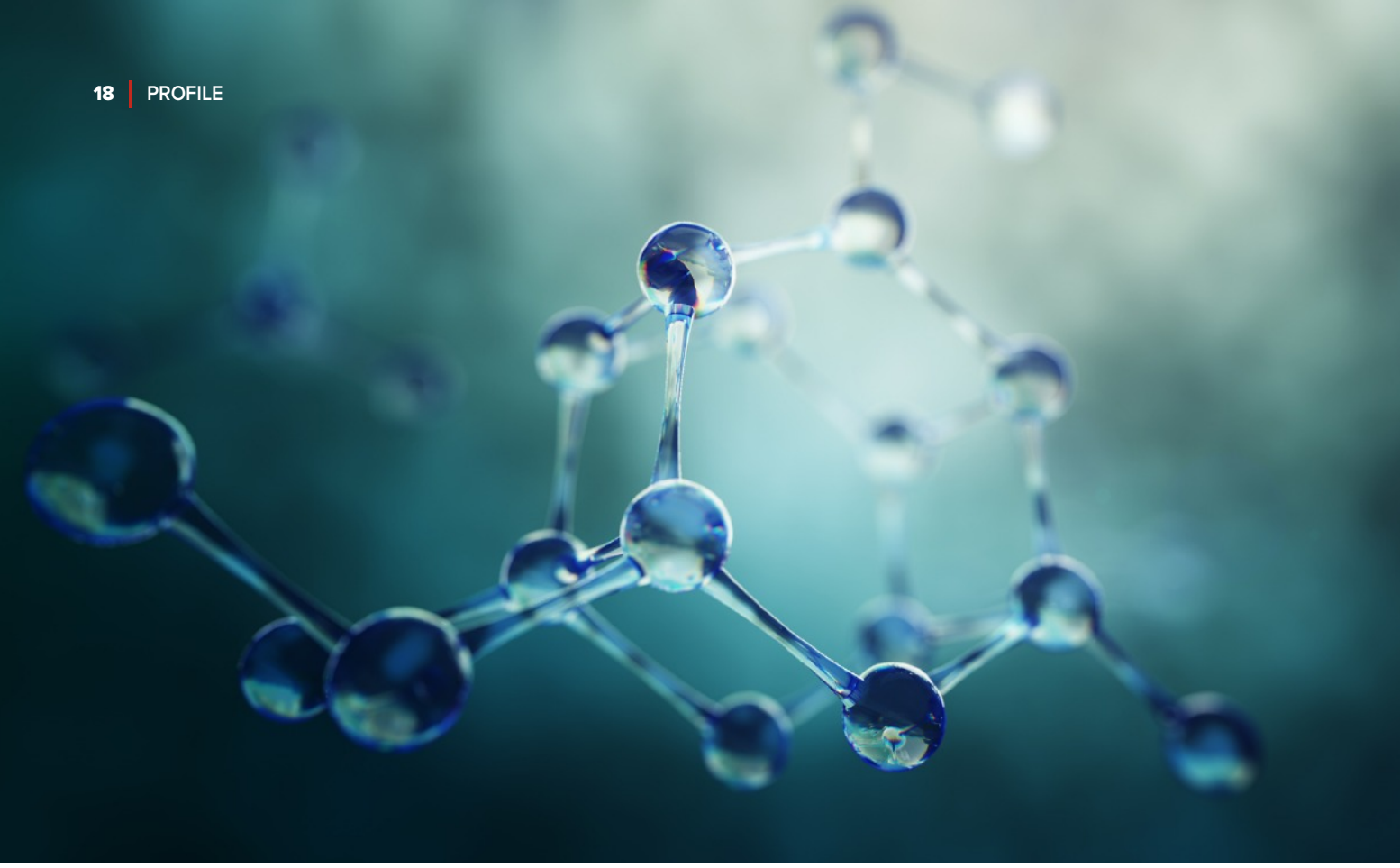

PROBING THE INDIVIDUALITY OF CELLS AND MOLECULES

Sotaro Uemura, Professor at the University of Tokyo, probes the individuality of cells and molecules

The Uemura Laboratory was established in the Division of Advanced Photon Life Sciences, part of the Department of Biological Sciences, Graduate School of Science, at the University of Tokyo. Our research centres on biophysics, focusing on studying single-molecule genetics, particularly the unique aspects of molecules and cells.

Human beings each have their distinct characteristics. Differences in things like gender, where we come from, physical attributes, health, and personality are examples.

Bringing all these different individual traits together creates diversity, and our society is built upon this diversity.

In society, we go through different life stages, such as moving up in school, getting jobs, sometimes getting sick, or experiencing accidents. This is how we live our lives, encountering various events along the way.

The individuality of cells and molecules

Interestingly, the cells and molecules that make up our bodies are just as unique as we are. They are constantly going through unexpected changes.

The "properties of cells" we learn about in school are just a basic introduction to their many characteristics. Because cells are so diverse, cancer cells, for example, some respond well to anti-cancer drugs, while others do not.

This is one of the reasons why treating cancer with medication can sometimes lead to the remaining cancer cells returning.

Among induced pluripotent stem (iPS) cells, which can transform into different cell types, some are cooperative and easily change into the desired cell type. In contrast, others are stubborn and refuse, saying, "I won't become that cell!" Some cells are so unresponsive that they remain idle and don't react to signals.

Similarly, cells are utterly unique. This also applies to the tiny building blocks of cells called "molecules." Even when molecules are the same type, they act differently; some often make mistakes.

The individuality of cells research

In our lab, we use special techniques to study the individuality of cells and molecules in detail. By understanding their characteristics accurately, we aim to personalise disease diagnosis, develop drugs, and uncover how molecules work in our bodies.

Here, I would like to introduce two recent research findings.

The first is our discovery regarding the relationship between cancer cells and cell death. [1] Telomerase reverse transcriptase (TERT) is well-known as an enzyme that elongates the telomere region of DNA. Still, it was observed that cancer cells tend to accumulate it in mitochondria when subjected to stress. However, the reason behind this mitochondrial accumulation remained unknown. In our approach to this issue, we focused on the individuality of cells in terms of when they die.

We developed a visualisation method that did not inhibit the function of TERT and measured the individuality of TERT within cells at the single-cell level during the process leading to cell death in cancer cells. As a result, it was suggested for the first time that the accumulation of TERT in mitochondria induces slow cell death.

This achievement not only sheds light on the novel relationship between cancer cells and cell death but also holds promise for the development of new strategies in cancer treatment.

Next, I would like to introduce our research findings on measuring the activation individuality of immune cells, directly recovering newly activated immune cells, and performing genetic analysis immediately after activation. [2] Through this research, we identified specific gene groups expressed immediately after the critical activation of immune cells, which is crucial for immune responses.

This discovery, achieved by measuring the individuality of immune cell activation at the single-cell level, can potentially lead to new treatment discovery approaches for autoimmune diseases, allergies, asthma, and other immune-related diseases.

These research findings have emerged only through investigating cell individuality at the single-cell level.

Nanopore measurement technology

Lastly, I would like to introduce our ongoing nanopore single-molecule measurement technology development.

Nanopore measurement involves dividing an electrolyte solution into two regions on a membrane plane and applying voltage to each side. If there are no holes in the membrane plane, no electric current flows. However, if a single nano-sized pore is present, measuring the current value through this single pore becomes possible.

When molecules pass through the pore, the current is temporarily blocked only while the molecule is passing through. The pattern of this blocked current contains information about the molecule, and by applying this technology to identify the four DNA bases, the DNA can be sequenced without any labelling.

We are utilising this technology to measure the individuality of various biomolecules at the single-molecule level, not limited to DNA.

Additionally, we are working on developing techniques to detect specific molecules from biological samples. For instance, detecting specific molecular markers from biological samples like blood or saliva may be possible. Due to the necessity of machine learning for analysing the electrical waveform data, we are currently exploring various approaches.

If these developments progress, they may replace conventional measurement methods that heavily rely on antibodies and fluorescence.

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TEACHING AND ASSESSING LITERACY USING A BALANCED APPROACH: EFFECTS OF CAN-DO SELF-ASSESSMENT ON EARLY EFL LEARNERS

Following the January and July 2023 issues, Emiko Izumi from the School of Education & Graduate School of Education at Kwansei Gakuin University discusses the content and results of her collaborative research on the teaching and assessment of reading and writing for early English as foreign language (EFL) learners in Japan

Reading and writing lessons should be conducted in small, incremental steps. Especially for Japanese learners of English, it is very difficult to learn the alphabet (upper- and lower-case letters) and to connect letters and sounds. The English language has a different phonological system and graphemes from Japanese, so it is important for learners to recognise phonemes and develop phonological awareness.

With this being said, we recommend a balanced approach that introduces bottom-up strategies, such as phonics instruction that teaches the rules for linking sounds and letters, and a top-down approach, such as understanding content from songs, stories, and picture books with a focus on meaning.

A bottom-up approach to teaching and assessing literacy: Correlations between self-rating and tests of alphabet and phonological awareness

Starting in 2020, when the latest national curriculum was introduced, students in the upper grades of Japanese public elementary schools are now able take twice-weekly foreign language classes. This article discusses a unique literacy education programme and the relationship between literacy and self-assessments of the students who participated in the programme.

In the district where the programme was implemented, about 15,000 students have received the systematic and explicit bottom-up instruction every year since 2017. This instruction involves about seven minutes of literacy instruction in a weekly class from the third grade.

Since 2016, Dr Mitsue Allen-Tamai, a member of Dr Izumi's research group, has been researching how students who received the literacy instruction evaluated their abilities. Among the many things we have learned, the Can-Do scale evaluation was very effective in allowing students to evaluate their ability accurately.

93 sixth graders participated in this study in 2022 and student self-appraisals were collected along with three criterion measures of reading ability: letter-name knowledge, sound-letter knowledge, and word knowledge.

The Can-Do scale self-assessment was used for letter-name knowledge and a three-point Likert scale assessment was used to evaluate their sound-letter knowledge (consonants, short vowels, consonant digraphs, and long vowels). We created experimental Can-Do scales for decoding.

This uses a five-level scale, asking at what level words can be read. Level 1 is the ability to read words with 'consonant + short vowel + consonant,' like cat and dog; level 2 includes words with consonant digraphs like shop and dish; level 3 includes words with consonant clusters like frog and clock; level 4 includes final-e words like cake and nice; and, finally, level 5 includes words with vowel digraphs like rain and boat.

As a result, 74% of the students were able to respond quickly to the uppercase letters and 67% to the lowercase letters, since the target was three or higher on a four-point scale. Based on the test results, the average percentage of correct responses for both uppercase and lowercase letters was close to 90%, so it can be said that the goal was achieved.

As for the relationship between sounds and letters, the children seemed to have the most difficulty with consonants, followed by two-letter consonants, short vowels, and finally long vowels, in this order. The second level of the three-level scale-"fairly well understood" was most popular, which meant that many children understood those sound-letter associations.

However, one-quarter of the students answered, "I don't understand at all" (level 1) for long vowels, so decoding words with long vowels was still perceived to be quite difficult for the elementary school children.

LBS Activities Using *Momotaro*. From Sorting to Retelling

Correlations between self-assessments showed that the strongest correlation was found between self-assessments of uppercase and lowercase letter knowledge (r = .914), followed by consonant and consonant digraph knowledge (r = .723), and finally between short and long vowel knowledge (r = .720).

Next, we examined the relationship between the skill measured in each test and its self-assessment. Interestingly, the highest correlation coefficient was found between each skill and the self-assessment of decoding, followed by that of consonants. It is interesting to note that the correlation coefficient between the test score of uppercase letters and the self-evaluation of decoding was higher than that between the test score and uppercase self-evaluation. The same was true for the lowercase, consonant, short vowel, and long vowel knowledge.

Teaching and assessing literacy through a top-down approach

As one sector of Dr Izumi's research group, the top-down method for fostering elementary school students' emergent literacy has been studied by Professor Mayumi Tabuchi and her colleagues. A series of effective English activities, followed by telling a story with the picture book, has been practiced and named the 'Learning by Storytelling' (LBS) method.

A qualitative analysis was conducted based on students' responses to three prompts. There were three questions to match the goal of each lesson for students to choose from four scales and a space for their free description to assess their own performance.

The LBS method consists of four main parts:

- Interactive storytelling, that is, telling the story of a picture book while interacting with students;
- Reordering the plot of the story as a class and in groups;
- Retelling the story in a group; and
- An output activity depending on the age and cognitive level of the students.

At a private elementary school where students are taught English twice a week, sixth graders (N=30) had five lessons under this LBS method and the Can-Do scale self-assessments were conducted four times. The results show the correlations between each unit quiz and its self-assessment increased (r = .492 to r = .691) as the lessons proceeded. It was also noted that those who assessed themselves as low as 1 (It is still very hard) or 2 (I could understand with the visuals in the book somehow) when asked "Do you understand the story?" had changed notably.

The qualitative analysis of the students' comments showed they gradually gained confidence in understanding the contents of the stories in English, even with their limited knowledge, scaffolded by visuals and the teacher's storytelling. Furthermore, they became more motivated to read the story on their own as they wanted to know what would happen next.

Teaching reading and writing to elementary school students in Japan started recently in 2020 and, due to the difficulty in understanding sound-letter relations and reading words, more research in this area is in urgent need. Besides the need to implement a balanced of both bottom-up and top-down approaches, we need to keep searching for more tools to assess Japanese people's reading ability as it is such a complex area.

Our study suggests that using this Can-Do scale self-assessment as a formative tool should share the teachers' goals with students, help students to realise for themselves what they can or cannot do, and lead to their increased self-efficacy.

小学校英語評価研究会 an-Do

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BUSINESS AND HUMAN RIGHTS IN JAPAN: RIGHTS HOLDERS' PERSPECTIVES

Emi Sugawara, Osaka University of Economics and Law, examines business and human rights issues in Japan with a focus on the priority issues from rights holders' perspectives

The United Nations Working Group on Business and Human Rights conducted a research visit to Japan from 24 July to 4 August. Japan was the eighteenth country to be visited by the working group under its mandate to disseminate, promote and implement the United Nations Guiding Principles on Business & Human Rights.

The working group is also mandated to exchange and promote good practices and lessons learned from the implementation of the guiding principles and assess and make recommendations thereon.

One purpose of the working group's visit to Japan was to examine business and human rights issues in the country. During the visit, the working group travelled all over Japan to Tokyo, Osaka, Aichi, Hokkaido and Fukushima, and engaged with the government and business sectors, civil society and various rights holders.

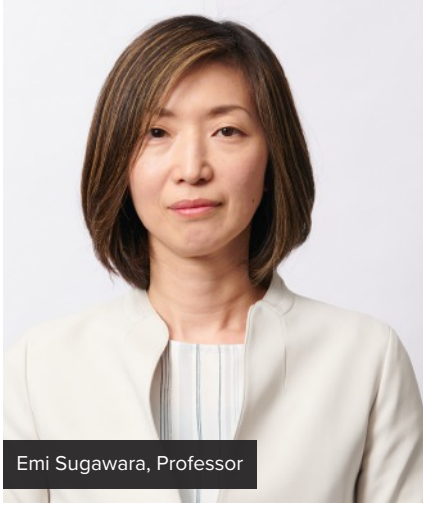
On 4 August, the final day of the visit, the working group announced its preliminary findings.[1] Its final observations and recommendations to the government of Japan and business communities will be presented at the UN Human Rights Council session in June 2024.

Issues from the perspective of rights holders

First, the working group's statement highlighted issues for business and human rights in Japan from minority stakeholders' perspective. Systemic challenges in the country/region emerge as human rights issues in business activities;[2] however, in Japan, these challenges, especially discrimination and abuse against minorities, have not been fully prioritised as business and human rights issues.

The working group's statement emphasised the need to re-examine issues from the perspectives of women, LGBTQ+ people, people with disabilities, Indigenous peoples, Buraku communities, labour unions, technical intern trainees, migrant workers and children and youth as minority stakeholder groups.

The employment of "Technical Intern Trainees" has been characterised as modern slavery. Many companies have made this a priority issue. Nevertheless, some Japanese companies believe "however, in prioritising human rights risk assessments by 'severity', the issues of gender and unconscious bias seem to be relatively hard to raise compared to forced labour, child labour and risks to the right to life".


Emi Sugawara, Professor

Human rights violations against Korean residents

One important issue in Japan that was not sufficiently addressed in the working group's statement was human rights violations committed against Korean residents. Korean residents in Japan are formerly colonised peoples and their descendants. Many Koreans migrated to Japan from Korea under Japanese nationality due to Korea's status as a colony.

However, after World War II, their Japanese nationality was rescinded by a unilateral notice from the government, but they continued to reside in Japan,

where they had already established a base for their livelihood. Even today, discrimination and violations against Korean residents in Japan are serious, and discrimination and harassment in employment and the workplace, hate speech and hate crimes continue.

Focus on downstream and entire supply chain

Second, the working group drew attention to "health, climate change and the natural environment" by highlighting issues in Japan from the perspective of local communities, the environment and human rights. In Japan, little attention is given to downstream effects, such as the human rights of consumers and local communities, and so the focus on human rights and the environment is weak.

Although directly addressing the Fukushima Daiichi Nuclear Power Plant accident is greatly significant, I would like to focus on Per- and polyfluoroalkyl substances (PFAS) issue. PFAS is a general term used for more than 10,000 organic fluorine compounds, of which Perfluorooctanesulfonic acid (PFOS) and Perfluorooctanoic acid (PFOA) are subject to regulations under international treaties because of their impact on health and precautionary principles.

However, according to the Environment Ministry's panel of experts,[3] the extent to which these substances affect the human body is not clearly understood. During the working group's hearing process, local communities from multiple locations raised grievances about facing water pollution caused by PFOS and PFOA.

Corporate activities that utilise PFOS and PFOA have been conducted in these regions. Recognising that this problem is related to local communities' rights to health, it is necessary for governments and companies to take measures and engage and communicate with communities to address this issue.

The third point concerns companies' responsibility to respect human rights holders in their supply chains. The guiding principles clearly state that companies have a responsibility to respect human rights not only within their corporate activities but also in the entire supply chain.

Regarding the Tokyo Electric Power Company (TEPCO), in addition to the human rights issues of rights holders who were affected by the accident at the Fukushima Daiichi Nuclear Power Station, human rights violations against workers responsible for decontamination work were addressed.

TEPCO's responsibility has been questioned for exploitative labour practices, such as low wages and forced labour, in its five-tier subcontracting structure, as well as for making workers hesitant to use the complaint system for fear of retaliation.

The working group also pointed out the media's responsibility for reporting violations on human rights in Japan. As guardians of freedom of expression, the media play a role in delivering the voices of right holders. However, the media have failed to fulfil their responsibility to respect human rights in response to human rights violations in the supply chain, considering issues such as sexual harassment and violence against children and youth by Johnny & Associates in the entertainment industry.

The need for a National Human Rights Institution

The working group has pointed out that Japan's civil society calls for a National Human Rights Institution (NHRI) in response to such serious concerns raised by the rights holders.

NHRIs monitor and advise the government's business and human rights policies, including the National Action Plan, and are also responsible for responding to grievances from rights holders about human rights violations by companies and conducting investigations.

The NHRI, an agency independent of the government at the national level, is needed as a remedy for business and human rights issues, even though some initiatives have emerged, such as Japan Platform for Migrant Workers towards Responsible & Inclusive Society (JP-MIRAI)[4] and Japan Center for Engagement & Remedy on Business & Human Rights (JaCER)[5].

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CAN WE DO DRUG REPOSITIONING WITHOUT DISEASE GENE EXPRESSION?

Chuo University's Professor Y-h. Taguchi examines the application of cutting-edge single-cell-based measurements in drug repositioning

Single-cell analysis is a new trend in genomic science. Prior to its development, measurements were made on whole tissues. However, because tissues are composed of millions of cells, measuring them can miss important information. Imagine trying to understand the economic status of a big city with millions of people based only on the average income. Even if two cities have the same average income, one might be a mixture of a small number of rich people and many poor people, while the other might be composed of people who have almost the same income. Without detailed information about the distribution of income, we would not be able to distinguish between the two cities from an economic point of view.

In the same way, single-cell measurements have opened the door to a true understanding of the genomic state of living material. By measuring the gene expression of individual cells, we can identify the different cell types present in a tissue and their relative abundance. This information can be used to understand how tissues function and how they respond to different stimuli.

Mice and Alzheimer's disease

In my previous studies on in silico drug repositioning,[1, 2] I only analyzed tissue-based measurements. In this article, I discuss how to use single cell-based measurements, a cutting-edge technology, for drug repositioning. [3]

The target of this study is Alzheimer's disease (AD), which destroys human brain cognitive function and lacks effective treatment. The data set analyzed includes two mouse brain tissues, the cortex and hippocampus, which are thought to be related to AD. Additionally, the measurements were performed in two distinct genotypes, which means that there are slight differences between the two groups to avoid the effects of small changes in the genome. Two sexes were also considered to avoid the effects of sex.

Then, the gene expression of single cells in these two tissues was measured at four time points: 3, 6, 12, and 21 weeks after birth. This means that the purpose of this measurement is to monitor how gene expression in the brain changes with age. Since aging is a primary factor in AD, it is expected that the dependence of brain gene expression on aging is deeply related to AD progression. However, no direct measurement of AD was performed.

Is it possible to find a drug candidate without direct information about the disease?

The method we used is tensor decomposition – TD. [4, 5] I will not discuss the method in detail here because of its mathematical nature. Those who are interested in the method itself can read my previous articles. It is not easy to integrate this complicated set of single-cell measurements successfully. Each measurement is associated with four plates, each of which contains 96 cells, for a total of 400 single cells. How can we integrate these data sets?

Ideally, the expression of the selected genes should be independent of sex, genotype, and brain location but should be dependent on aging, if possible, monotonically. This is not an easy task, as there is no practical way to select genes whose expression is independent of various conditions.

Using various statistical tests, we can evaluate whether the gene expression is different between two conditions by evaluating the probability under the null hypothesis that the two conditions have the same distribution. (If the probability of the difference is very small, we can conclude that the difference is statistically significant.) However, even if the probability is not small enough, we cannot say that the distributions under the two conditions are identical; we can only say "no conclusion."

Tensor decomposition allows us to do this easily, as it can tell us which genes are independent of various conditions. Another advantage of TD is that it is an

unsupervised learning method. Popular machine learning methods, such as ChatGPT or Stable Diffusion, require massive datasets from which the machine learning algorithm can learn. These methods also require a long computation time to learn. Unsupervised methods are much faster, as they do not have to learn anything.

Using TD, we were able to identify as many as 401 genes. Although this number may seem large, it is only a small percentage of the total number of mouse genes, which is 20,000. This means that TD was successful in reducing the number of genes to those that are most promising.

Using the data

The screening of known drugs using the list of 401 genes was simple. There are many databases that store gene expression changes caused by drug treatment. We can compare the 401 genes we selected with those whose expression is changed by individual drug treatments. We can then rank the drugs based on the number of matches between the 401 genes we selected and the genes whose expression is changed by a specific drug treatment.

Surprisingly, even though we did not deal with gene expression of AD, but only those associated with aging, we were able to identify several promising candidate compounds. Two of the top compounds based on the "LINCS L1000 Chem Pert up" database, alvocidib and AZD-8055, were once tested as promising candidates for AD drugs. Even using another database, "DrugMatrix", the top, fifth, and tenth ranked compound, "cyclosporin-A", was also tested as a promising candidate for AD. We also tested the "Drug Perturbations from GEO up" database, and the top ranked compound was imatinib, which was also previously tested for AD.

In contrast to previous studies, [1, 2] which required disease gene expression, we were able to successfully show that we do not even need disease gene expression to identify effective drugs for diseases. This is possible if we use my TD method, which can be easily used by anyone with access to the two freely available Bioconductor packages, TDbasedUFE and TDbasedUFEadv. [6]

I encourage readers to try this method themselves, as they may be able to identify new candidate drugs that could help many patients. This can be done by simply using computers and public-domain datasets!

In conclusion, we have proposed a new method that can identify drugs without using disease gene expression. This method is very promising, and it has the potential to revolutionize the way we develop new drugs.

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AI CONSCIOUSNESS AND NEUROSCIENTIFICALLY PLAUSIBLE "SEAMLESS" MIND-UPLOADING

Masataka Watanabe, Associate Professor at the University of Tokyo's School of Engineering, examines a test for AI consciousness. He proposes it as part of a scientific approach to deciphering consciousness that leads to "seamless" mind uploading

Today, there is much debate on whether artificial intelligence (AI) has achieved consciousness. [1, 2] My short answer is probably not, but with dedicated substantial resources, AI will achieve consciousness at some point.

So, what is consciousness? Could we ever tell whether it resides in AI? How can we build a conscious AI, and what would be the purpose of doing so?

Defining consciousness

According to the philosopher Thomas Nagel, "an organism has conscious mental states if and only if there is something that it is like to be that organism – something it is like for the organism." [3] We can be sure that there is an element of what it is like to be a human. We experience vision, audition, and various other sensations through our brain.

What about smartphones equipped with modern AI? When we record videos on our phones, it not only records visual information but also detects faces, etc., on the fly and adjusts its lens for focus. But when all that is happening, is there something to being a "smartphone"? Are they seeing the world as we are? Most probably not.

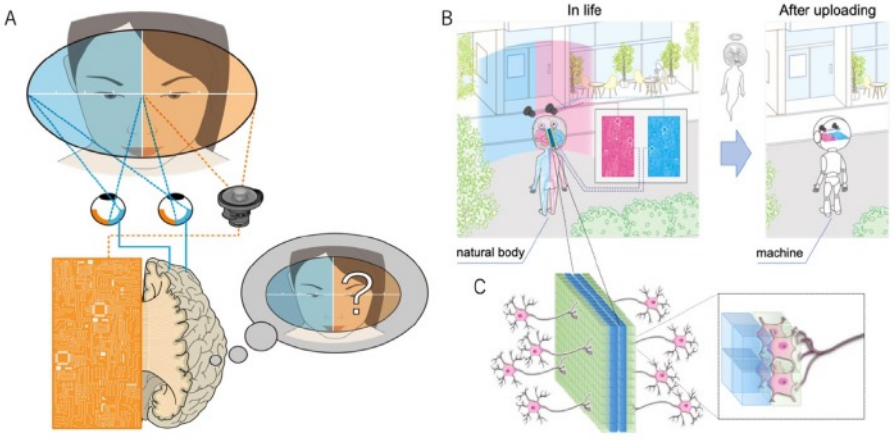

Figure 1. A) A test for AI consciousness B) Integrating AI and biological hemispheres with C) a radically new brain-machine-interface that reads and writes from the surface of dissected axonal bundle (e.g., corpus callosum)

Difficulty in testing AI consciousness

The difficulty in testing AI consciousness is that we must account for philosophical zombies, a concept proposed by the philosopher David Chalmers. A philosophical zombie is indistinguishable from a normal human being in terms of its appearance or behaviour; the only difference is that a philosophical zombie lacks consciousness.

Philosophical zombies are an imaginary construct, but a necessary one for working out the constraints of testing AI consciousness; it hinders testing with objective measures such as externally observing stimulus responses.

Together, according to the Mill Argument by the philosopher Gottfried Wilhelm Leibniz, it is also impossible to judge by deciphering its inner workings.

Need for a subjective test

If it is impossible to objectively test for AI consciousness, only one method remains: making use of subjectivity. We need to connect our own brains to the machine and "see" for ourselves whether consciousness resides within.

One critical issue is how we connect the machine to our own brains. We need a way to connect the device so that we obtain a subjective sensory experience, and only when consciousness resides in it.

My proposed test for machine consciousness takes advantage of the primary–primary constraint of our visual system (Fig.1A). [4,5] As shown by Sperry's Nobel prize-winning study, with regard to visual consciousness, the left and right hemispheres are equal. Namely, there is no asymmetric relationship in which one hemisphere generates consciousness while the other just provides it with visual information.

The test runs as follows: replace one of our hemispheres with an AI hemisphere to see whether we subjectively experience integrated visual fields, including the side that the mechanical hemisphere processes. If we do, from the primary–primary constraint, we must conclude that a stream of visual consciousness resides in the AI hemisphere and that it is linked to our own biological stream of consciousness.

Building conscious AI: Mind uploading

Many scientists believe that, in principle, conscious AI is possible; if we manage to sufficiently replicate the neural circuitry and dynamics of a human brain in artificial neural networks, it would be rather mysterious if consciousness does not reside.

But then, what would be the very purpose of developing AI consciousness? If our only goal is to develop an AI that acts like it were conscious, the authenticity of that consciousness is unimportant.

As long as AI behaves as if it is conscious, we don't need to determine whether it genuinely is. However, if our goal is to upload our own mind, things are very different; we certainly wouldn't want to find ourselves transformed into a philosophical zombie after the process.

AI consciousness: A scientifically feasible path to seamless mind uploading

I put forward a three-step procedure to realise AI consciousness and, subsequently, "seamless" mind uploading.

In the first step, a neutrally conscious device is constructed. The idea is to prepare a spiking neural network (SNN) that replicates the full connectivity of the human brain based on data obtained from future invasive connectome projects. From there, to determine the fine quantitative values of neuronal connectivity and develop the device into a visual system, for instance, we can show it a life's worth of video material.

By using advanced methods for training SNNs, the final result should mimic a human brain, and most likely, neutral consciousness, or a 'one-size-fits-all' type of consciousness would likely kick in. The beauty lies in the fact that we may test whether consciousness has actually emerged using the above-proposed test.

Once we know for certain that the AI hemisphere is conscious, we are only one step away from mind uploading. Since the two streams of consciousness – one in AI and the other in the biological hemisphere – would be readily integrated, all we need to do is to transfer memory from the biological to the AI side.

This step includes natural and forced memory retrieval in the biological hemisphere, leading to synchronised retrieval in the artificial hemisphere due to integrated consciousness between the two. Finally, memory consolidation is achieved in the device side with brain-like mechanisms.

Once consciousness is fully integrated and sufficient memories have been transferred, we will be ready to face the inevitable closure of the two biological hemispheres. This closure would be like suffering a massive stroke in one of our hemispheres where our consciousness seamlessly continues in the other hemisphere, except that our consciousness will continue in the two AI hemispheres, to be integrated later (Fig. 1B, C).

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CRAFTING INVESTMENT MODELS THROUGH CONTRADICTORY VALUE AND MOMENTUM INVESTMENT STRATEGIES BY ARTIFICIAL INTELLIGENCE

Professor Chien-Feng Huang discusses how Artificial Intelligence could provide innovative models and strategies to solve investment problems

Over the past decade, Professor Chien-Feng Huang has been working on several investment problems using Artificial Intelligence (AI). Big Data technology, data mining and machine learning play crucial roles in his research, where he hopes to discover niches and innovative solutions to bring about blue ocean strategies for investment.

One major line of research Professor Huang has been pursuing is to combine seemingly contradictory strategies to generate emerging solutions for investment. For example, the momentum investing strategy might advise buying a stock, yet the value investment strategy advises against it. So, which one is right?

Are further solutions created by combining these contradictory strategies to supersede the old ones? In other situations, various useless strategies, when fine-tuned, often become critical components of a powerful investment toolset. For such questions, Professor Huang's research showed that AI-based methodologies are promising in assisting with solving such problems.

Genetic algorithms to construct investment models

It turns out that problems with multiple conflicting strategies can be transformed into a class of combinatorial problems frequently studied in operation research and optimization. To shed light on such combinatorial optimization problems, as an illustration, Professor Huang and his team employed Genetic algorithms (GA) [1] to construct novel intelligent dynamic investment models by properly combining value investment and momentum investment strategies.

In the model, they selected five momentum indicators: Trading volumes for individual stocks, trading values for individual stocks, net buy/sell value of three institutional investors, net buy/sell volume of three institutional investors, and monthly return rates. Six value indicators were also selected, including price-earnings ratio (PE), return on assets (ROA), return on equity (ROE), dividend yield, and year-on-year revenue growth rate (YOY). Then, the GA is used to evolve models with optimal weights and factors for the momentum and value investment strategies.

Genetic algorithms are well-known as a class of adaptive algorithms which solve optimization problems.
GA operate on an evolving population of artificial agents. Each agent comprises a genotype (often a binary string) encoding a solution to some problem and a phenotype (the solution itself). During evolution, new generations are created through selection, crossover and mutation to produce fitter agents (solutions) to solve a problem. The core of GA lies in the production of new genetic structures through evolution, which gradually provides innovative solutions for the problem at hand.

Utilizing binary encoding

As suggested by Huang [2] and as demonstrated by Huang and his lab members, to solve the combinatorial problems of momentum and value strategies, the optimization of indicators selection, value and momentum indicator, weights as well as holding durations can be achieved through

Bit	1	2	3	4	5	6	7	8
	On/off	On/off	On/off	On/off	On/off	On/off	On/off	On/off
Rules	m_1	m_2	m_3	m_4	m_5	v_1	v_2	v_3

Bit	9	10	11	12~15	16~19	20~24	25~28
	On/off	On/off	On/off	Weights	Weights	Integer	Integer
Rules	v_4	v_5	v_6	W_{ma}	W_{mb}	l_{tb}	l_{ta}

The parameters in the encoded strings are:

Parameters	Parameter Name
Momentum Indicators	$m_1, m_2, \ldots, m_5$
Value Indicators	$v, v_2, \ldots, v_6$
Bull/Bear Market Momentum Weights	W_{ma}? W_{mb}
Bear Market Holding Months	l_{tb}
Bull Market Holding Months	l_{ta}

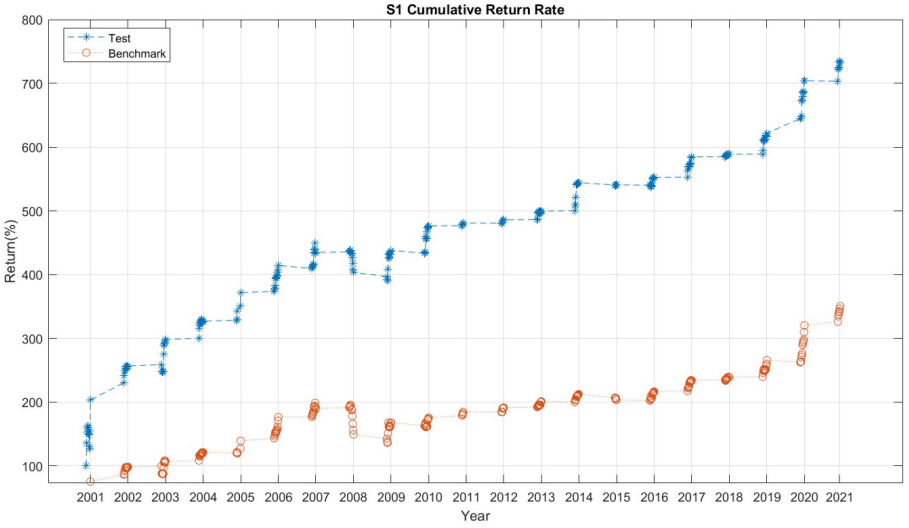
Figure 1: The GA Encoding by binary string

the GA. For instance, they utilized binary encoding for the investment models. Each model consists of several binary-string blocks, with each block of 28 bits as displayed in the following table:

Some illustrative results are shown in the figure below, where the red curve is the investment performance of the benchmark (Taiwan Stock Exchange Capitalization Weighted Stock Index) and the blue curve is the proposed model. The performance discrepancy is getting more significant along the course of investment.

Conclusion

The research findings also indicate that the primary indicators affecting the model performance include the momentum indicators 'monthly return rate,' as well as value indicators such as 'dividend yield' and 'price earnings ratio.' During bullish periods, the weight of the momentum indicators was notably higher than that of the value indicators. In contrast, during bearish periods, the effects of value indicators were more significant than the moment indicators.



This observation highlights the characteristics of investment in the stock market of Taiwan: during bullish and bearish periods, momentum strategies and value strategies are more useful, respectively. Thus, the results of this research can serve as a valuable reference for investors.

Acknowledgement

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Technological advances in irrigation techniques

Aarthi Janakiraman, Research Director at TechVision, Frost & Sullivan, explores technological advances in irrigation techniques that aid in preserving crop yield and quality in drought-prone areas

Climate change has become a cause of concern across various geographies and demographics. It has resulted in changes in ecological patterns, an extension of arid zones, the depletion of glaciers, and a temperature rise, to name a few. These changes have a far-reaching impact on various key sectors, one being agriculture.

The effect of climate change and global warming has resulted in shifts in the soil ecosystem, including the biome, and a decrease in water resources, amongst others, leading to changes in the soil-water nexus; this has adversely affected crop quality, requiring higher amounts of external intervention such as fertilisers and other crop aids.

This further creates soil ecosystem imbalance, leading to a vicious cycle. The situation is more prominent in regions dependent on seasonal rainfall for agricultural activities and drought-prone areas, leading to crop failure and economic losses. Due to the increasing changes in weather patterns, it's imperative to adopt agricultural practices that can withstand temperature, water, and cold changes, to name a few.

Irrigation techniques in agriculture

Effective irrigation techniques enable farmers to mitigate some of the challenges associated with water scarcity, especially for perennial crops and drought-prone regions. Several factors influence the choice of the irrigation method, ranging from the type of soil, crop, water availability, and access to other resources.

Growing pressure in Europe regarding water conservation, policies underlining sustainable water practices in agricultural activities, and water conservation strategies have led to many agricultural sector research and innovation activities, especially related to water use for perennial crops, the foremost being irrigation techniques.

Within perennials, it's a well-known fact that wine-producing regions in Europe and the U.S. have witnessed incidences of drought that have affected grape production and quality, leading to implementing water management strategies that can ensure quality, yield and preserve the vines. Irrigation techniques have played a vital role in the same. European vine growers are actively adopting various emerging irrigation technologies, with drip irrigation as one of the widely used ones.

Drip irrigation is well established

Drip irrigation has come a long way since its introduction in Israel during the 1950s and 1960s. Drip irrigation is well established, mainly because it can help uniform water distribution, which is especially needed in vineyards. To further improve the effectiveness of drip irrigation, vine growers use soil sensors and automated systems to improve their water management strategies further.

Research efforts from universities such as Washington State University have established subsurface drip irrigation practices that can overcome the challenges of prolonged use of drip irrigation, such as soil clogging and damage of lines due to pests and other factors. Research studies and pilot trials show that subsurface drip irrigation can improve physiological activity while maintaining grape quality.

Studies have also shown the effectiveness of deficit irrigation during growth stages in drought-prone areas to stabilise production; a variant of deficit irrigation, known as partial rootzone irrigation, is being studied for its ability not to cause drought-related stress in vines while helping to optimise yield.

Another advantage of this technique is that it can be used in tandem with other irrigation approaches, including drip, to improve crop water productivity and grape quality. Using regulated deficit irrigation, maintaining soil moisture threshold, and continuous monitoring to modify approaches to save yield and vines have resulted in success stories.

Image: © mgstudyo | iStock

Are irrigation practices alone sufficient for crop productivity?

Despite the positive outcomes of using advanced irrigation techniques, it's understood that irrigation practices alone are insufficient to ensure crop productivity. Combining fertigation and integrated pest management with irrigation will yield better results while reducing soil nutrient imbalance and ensuring optimal plant growth during the growth phase rather than harvesting stages. Biostimulants can also help manage water stress and provide a more environmentally friendly approach to plant growth.

Combining these practices with automation and continuous monitoring technologies can help meet cost economics and achieve better yield while minimising workload for growers. While drip and sprinkler irrigation techniques are rising, integrating them with other techniques is still nascent. Proven long-term results regarding high yield, cost economics, and water savings can help improve adoption.

An integrated approach that includes educating the farmers on policies and ways to overcome challenges related to climate change, implementing new technologies, and conducting periodic trials to update and modify approaches as needed can help maximise yield and achieve economies of scale.

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UNDERSTANDING TAIWAN'S OFFSHORE WIND INDUSTRY

Here, Open Access Government speaks to Gwo-shyh Song, Chairman of MMA Global Aqua, and explores the challenges, successes and long term plans for the offshore wind power projects in Taiwan

Can you provide an overview of the current state of the offshore wind industry in Taiwan and its significance in the country's energy transformation?

Taiwan had no experience in offshore wind power development in the past.

The offshore wind power industry includes wind farm developers, who conduct environmental assessments of wind farms, as well as wind turbine system suppliers, marine engineering companies, cable manufacturers, and wind farm operators.

Therefore, the Ministry of Economic Affairs allows 100% foreign ownership to attract foreign investment and gradually increases domestic demand to cultivate local related companies in order to achieve the goal of offshore wind power localization.

Taiwan's offshore wind power development is divided into three stages:

1. Demonstration wind farm

2. Potential site

3. Block development

In January 2013, the Taiwan offshore wind farm demonstration project was opened for bidding; In April 2017, the first phase of Ocean Wind Power's Ocean Zhunan Wind Farm began commercial operation, becoming the first officially operating offshore wind farm in Taiwan.

In 2018, the government launched a large-scale development of offshore wind power, announced the "Offshore Wind Power Planning Site Capacity Allocation Procedures", and launched the "selection" and "bidding" for offshore wind power.

On April 30, 2018, the selection was completed, with a total of 3,836 MW allocated; on June 22, the same year, the bidding was completed, with a total of 1,664 MW allocated. The total of the selection and bidding is 5.5 GW, which will be completed in stages from 2020 to 2025.

Could you elaborate on the specific policies or incentives that have attracted international developers to invest in Taiwan's offshore wind sector?

The Taiwanese government supports the development of domestic offshore wind power projects through a series of policies, regulations, and investments to achieve the goals of energy diversification, carbon reduction, and energy security. These policies and measures help to attract investment, promote technological innovation, and drive the growth of renewable energy in Taiwan.

In addition to setting relevant policies to increase the share of renewable energy, especially wind energy, the government sets offshore wind power installation capacity targets to encourage investors to participate in projects. It also provides fixed buyout prices or reasonable repurchase prices to ensure the feasibility and return on investment of offshore wind power projects.

Furthermore, the government invests in offshore infrastructure, such as dedicated wind power ports, transportation facilities, and power grids, to support the construction and operation of offshore wind power. In terms of environmental regulation, the government also ensures that offshore wind power projects comply with environmental regulations and requires environmental impact assessments to reduce the potential impact on the ecology and environment.

The Taiwanese government has established the "Offshore Wind Power Demonstration Incentive Regulations" to encourage the development of offshore wind power. The regulations provide financial assistance to companies that install offshore demonstration wind farms. The government will provide up to 50% of the cost of installing demonstration offshore wind turbines.

What are the major challenges and opportunities in meeting Taiwan's localization requirements for offshore wind projects, including "Made in Taiwan" components?

There are the following challenges and opportunities to meet localization requirements:

a. Costs increased: Localizing the supply chain may increase costs, including production, equipment investment, and labour costs.

b. Technology transfer: Introducing new technologies or transferring technologies may require time and resources.

c. Performance quality: Ensuring that locally produced components meet international standards.

d. Supply chain risk: Reliance on a local supply chain may increase risk, especially in the event of natural disasters or supply chain disruptions.

e. Job opportunities: Local production will create jobs, helping to boost economic growth and technical training.

f. Technology development: Conducting technology transfer and research and development has the potential to promote the development of new technologies in Taiwan.

g. Local industry: Strengthening the development of Taiwan's wind energy industry could help establish a local supply chain and promote the formation of industrial clusters.

Could you share some of the key challenges the developers encountered in offshore wind projects?

The main challenges faced are as follows:

a. Environmental challenges: Taiwan's typhoons and northeast monsoons create unfavourable conditions for construction.

b. Localization: Meeting the Taiwanese government's localization requirements, including the use of "Made in Taiwan" components, may present challenges in terms of supply chain management and cost control.

c. Environmental protection and community opposition: Offshore wind power projects may have an impact on local ecosystems and marine environments, leading to opposition from environmental groups and local communities.

d. Financial and investment challenges: Offshore wind power projects require significant investment, which may present challenges in terms of financing, risk management, and return on investment.

e. Talent training difficulties

What is your long-term vision for MMA Global Aqua's role in the offshore wind industry?

Our company can establish long-term partnerships with a portion of the wind power developers to support the development and operation of offshore wind power projects, such as:

a. Infrastructure design and construction: to understand seabed topography and geomorphology that is essential for the design of wind power infrastructure.

b. Submarine cable laying: to assist in planning and implementing submarine cable laying to ensure its stable operation.

c. Environmental impact assessment (EIA): to assess the impact of the project on the marine environment to ensure the sustainability of wind turbine operation.

d. Regular monitoring and maintenance: to provide regular seabed topography and geomorphology monitoring services to ensure the stability of the wind turbine infrastructure and respond quickly to any changes in topography.

e. Technology development: to promote our company's research and development of new technologies and methods to improve seabed exploration techniques, and improve accuracy and efficiency.

The above roles can ensure the success and sustainable operation of offshore wind power projects in the marine environment. Through effective cooperation, we can better manage the risks of wind power infrastructure, improve project efficiency, and ensure compliance with environmental standards.

MMA GLOBAL AQUA

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