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Deep space exploration: When the unknown becomes known

PAIR Newsletter

ISSUE 11 · *September 2024*

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香港理工大學高等研究院

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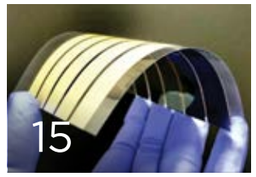

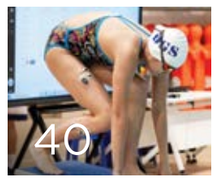

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In Issue 11 of the PAIR Newsletter, we are thrilled to share with you a selection of innovations at PAIR which have made significant contributions and received tremendous recognition at the national and international levels.

In late June 2024, China's Chang'e-6 lunar probe completed the first mission in human history to collect rock samples from the far side of the Moon. The tasks of automatic sample collection and packaging on the lunar surface were accomplished with the help of the Surface Sampling and Packing System, which was developed by the Research Centre for Deep Space Explorations (RCDSE) in collaboration with the China Academy of Space Technology. The success of Chang'e-6 underscores the University's world-class scientific and technological competence and embodies PolyU's devotion to national development through sci-tech undertakings.

In the Knowledge Transfer section of this newsletter, you will find more information about the space instruments, as well as other PolyU-led innovations with profound impacts on the promotion of human health. These include the world's first portable High-Definition Corneal Topographer, developed by the Research Centre for SHARP Vision (RCSV) to enable diagnosis of vision problems (e.g., corneal astigmatism and corneal ectasia) in as little as one minute; and the Magnetic Resonance Imaging Contrast Enhancement System developed by the Research Institute for Smart Ageing (RISA), which enables the precise detection of tumours without the use of contrast agents. These two innovations were awarded Gold Medals at the 49th International Exhibition of Inventions of Geneva. The Research Achievements section covers a range of PAIR-developed solutions for sensing, buildings and infrastructure, rehabilitation, novel materials, textiles and healthcare. A number of these innovations also won awards at the Expo.

Another highlight is the Feature Stories section. We talked to PAIR Senior Fellow Prof. LIN Jianguo about a researcher's dual role as scientist and entrepreneur, and PAIR Fellow Prof. Alex MIHAILIDIS told us about the use of elder care technologies to build age-friendly cities and communities. We also cover the work of Prof. George Q. HUANG, Director of the Research Institute for Advanced Manufacturing (RIAM), who is unveiling how disruptive technologies can enable a range of decision science solutions for iFactories.

Last but not least, the People section covers PAIR scholars who have received considerable external funding for their projects and awards for their research contributions. The News & Events section includes a number of recent and forthcoming knowledge exchange events at PAIR. Please stay tuned to to PAIR social media channels for the latest event updates and announcements!

Knowledge Transfer

RCDSE contributes to Nation's historic Chang'e-6 lunar far-side sampling mission and studies water in Chang'e-5 lunar soil samples

On 3 June 2024, following the soft landing of the Chang'e-6 probe, the PolyU-developed "Surface Sampling and Packing System" accomplished the tasks of automatic sample collection and packaging on the lunar surface, marking a milestone in human space exploration. The probe took off from the Moon on 25 June 2024, transporting the first-ever lunar soil samples from the far side of the Moon to Earth.

The system was developed and manufactured by a research team led by Ir Prof. YUNG Kai-leung, Director of the Research Centre for Deep Space Explorations (RCDSE), Sir Sze-yuen Chung Professor in Precision Engineering, Chair Professor of Precision Engineering and Associate Head of the Department of Industrial and Systems Engineering, in collaboration with the China Academy of Space Technology (CAST).

Unlike previous methods adopted by other countries that involve drilling or manual excavation, PolyU's Surface Sampling and Packing System performs fully automated multi-point lunar surface sampling with a packaging mechanism. In Hong Kong, PolyU was involved in the design and manufacturing of Samplers A and B, together with two high-temperature near-field cameras for multi-point surface sample collection and for automatic vision guidance of the sampling, sample deposition, and sample container pickup and precision placement into the ascender. The PolyU-designed and -manufactured flight units also included a primary sealing and packaging system that consisted of a sample container and its sealing mechanism.

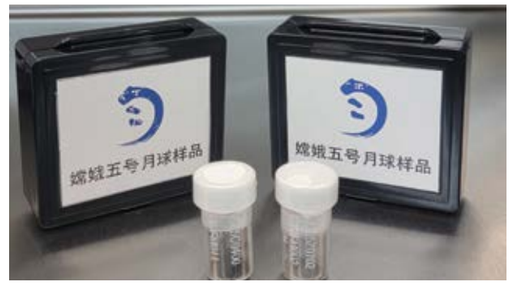
The sampling process started with the near-field cameras mounted on the robotic arm next to Samplers A and B. These cameras guided the sampling and subsequent deposition into the PolyU sample container in the primary sealing and packaging system. Upon completion of the sampling process, the sample container was sealed by the sealing and packaging device

for pick-up by the sampler, which was vision-guided by the near-field cameras for automatic precision insertion into the ascender and transport back to Earth.

On the other hand, with approval from the Lunar Sample Management Office under the China National Space Administration's Lunar Exploration and Space Engineering Centre, the PolyU team obtained two distinct lunar soil samples collected in Chang'e-5 mission: a surface soil sample weighing 400 milligrams, which was collected by the Surface Sampling and Packing System, and a subsurface soil sample weighing 42.6 milligrams. The samples are currently stored on the PolyU campus in the lunar regolith storage and analysis system, which is a unique state-of-the-art integrated multifunctional system for in-situ analysis. Researchers will thus be able to comprehensively study the lunar regolith without needing to leave the storage environment.

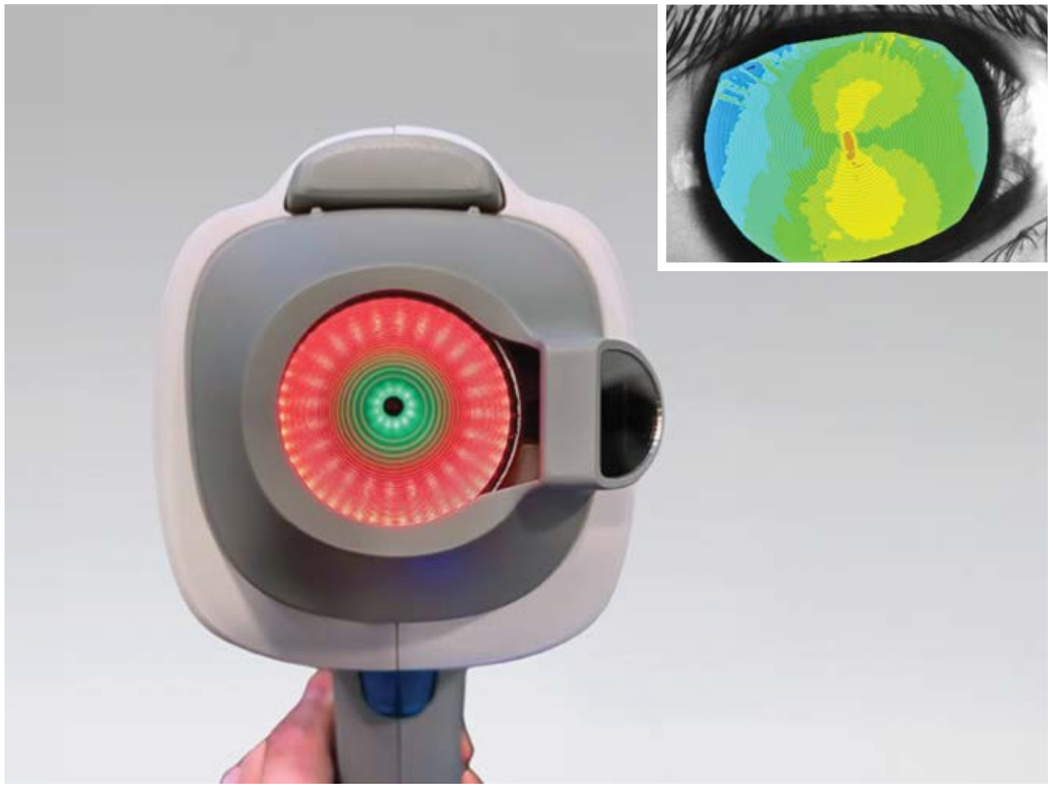
The Chang'e-5 lunar sample in-depth analysis and research programme is being conducted by a team led by Prof. Yung and Prof. WU Bo, Associate Director of RCDSE. The research team also includes Dr WANG Xing, Postdoctoral Fellow in the Department of Land Surveying and Geo-Informatics (LSGI), and Dr Sergey KRASILNIKOV, Research Assistant Professor in the same department.

The team will delve into "Finding Water in Lunar Soil" through a microstructural analysis of lunar regolith, including its water content and formation process. The findings will provide insight into the formation of soil on the surface of the Moon and other celestial bodies, as well as lunar water resources induced by solar wind implantation.



The lunar soil samples are rare and scientifically valuable, holding immense potential for pioneering scientific discoveries and future utilisation of lunar resources. A single grain of lunar soil may hold the key to the mysteries of the Moon's formation, evolution, and dynamic environment. The achievements of lunar sample research can also bring long-term benefits to Earth and humankind.

Prof. KEE Chea-su develops world's first portable High-Definition Corneal Topographer



Prof. KEE Chea-su, Associate Director of the Research Centre for SHARP Vision (RCSV) and Head and Professor of the School of Optometry, and his team developed the world's first portable High-Definition Corneal Topographer. The innovation leverages artificial intelligence-driven algorithms to accurately measure corneal power, provide early diagnosis of vision problems such as corneal astigmatism and corneal ectasia, and simplify the diagnosis process—enabling diagnoses in as little as one minute. The topographer has been patented and licensed to two companies and will be available in the market in 2025.

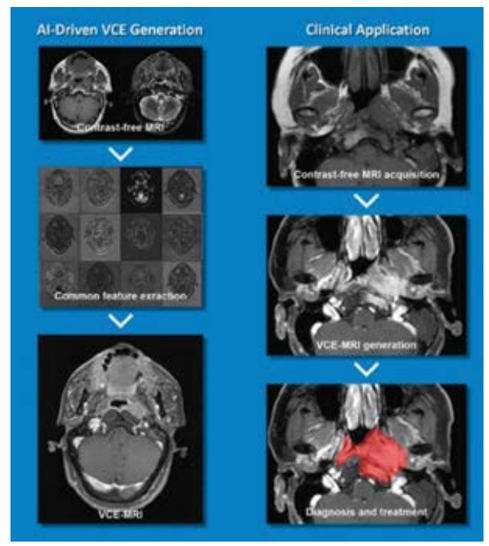
The innovation was awarded the Prize of the Saudi Arabian Delegation and Gold Medal at the 49th International Exhibition of Inventions Geneva.

Virtual MRI contrast enhancement system for precise tumour detection and treatment

Prof. CAI Jing, Management Committee Member of the Research Institute for Smart Ageing (RISA), Associate Dean of the Faculty of Health and Social Sciences and Professor in the Department of Health Technology and Informatics, developed a Contrast-Free Virtual Enhancement MRI System that revolutionises the precision of tumour treatment by providing high-resolution imaging without the use of contrast agents.

The system leverages advanced algorithms and innovative imaging techniques to precisely visualise tumours, thus facilitating treatment planning and accurate monitoring. The system offers advantages in terms of patient safety, cost-effectiveness and enhanced accuracy. It eliminates the use of contrast agents, thereby prioritising patient well-being and minimising potential health and safety risks in tumour detection and treatment. The enhanced accuracy of tumour visualisation improves treatment outcomes and patient care.

The novel system sets a new standard for non-invasive, safe and highly accurate tumour imaging. It advances the field of precision medicine and improves patient outcomes in the fight against cancer. The system has been patented to MedVision Limited, a PolyU start-up, for distribution.



Research Achievements

Prof. WENG Qihao develops deep learning-based super-resolution method to estimate building heights

Prof. WENG Qihao, Associate Director of the Research Institute for Land and Space (RILS), Director of the Research Centre for Artificial Intelligence in Geomatics, Member of the Otto Poon Charitable Foundation Smart Cities Research Institute (SCRI) and Chair Professor of Geomatics and Artificial Intelligence, and his research team have published a study titled “A deep learning-based super-resolution method for building height estimation at 2.5 m spatial resolution in the Northern Hemisphere” in the journal *Remote Sensing of Environment* (www.sciencedirect.com/science/article/pii/S0034425724002591).

Building height is an important indicator for assessing the level of urban development along the vertical dimension. Existing large-scale building height estimation methods focusing on coarse spatial resolution cannot reveal height variations across buildings in urban areas.

The team proposed a deep learning-based super-resolution method to generate building height maps. The researchers created an open building height dataset with 45,000 samples covering 301 cities in the Northern Hemisphere, including China, the conterminous United States, and Europe. The dataset has great potential for use in high-resolution database updating, urban planning, and natural disaster assessment. The study has also provided a new perspective on the application of cutting-edge satellite imaging technology in urban observation, measurement, monitoring, and management.

Novel remote sensing image classification for land use and land cover mapping in cloud-prone areas

Prof. WENG Qihao, Associate Director of the Research Institute for Land and Space (RILS), and his team have developed an integrated time series mapping method to enhance land use and land cover (LULC) mapping accuracy and frequency in cloud-prone areas. Other key PolyU members on the research team include Prof. DING Xiaoli, Director of RILS, and Dr LI Zhiwei, Research Assistant Professor in the Department of Land Surveying and Geo-Informatics.

The method incorporates spectral-indices-fused deep learning models and time series reconstruction techniques. When the team applied the method to the cloud- and rain-prone Pearl River Delta (i.e., Guangdong–Hong Kong–Macao Greater Bay Area, GBA), it yielded an overall mapping accuracy of up to 87.01%, outperforming existing LULC products.

This method has the potential to generate seamless and near-real-time maps for different regions of the world by using deep learning models trained on datasets collected globally. It can provide high-quality LULC data sets at different time intervals for various land and water dynamics in cloud- and rain-prone regions.

PolyU study reveals effectiveness of GBGI infrastructure in mitigating urban heat

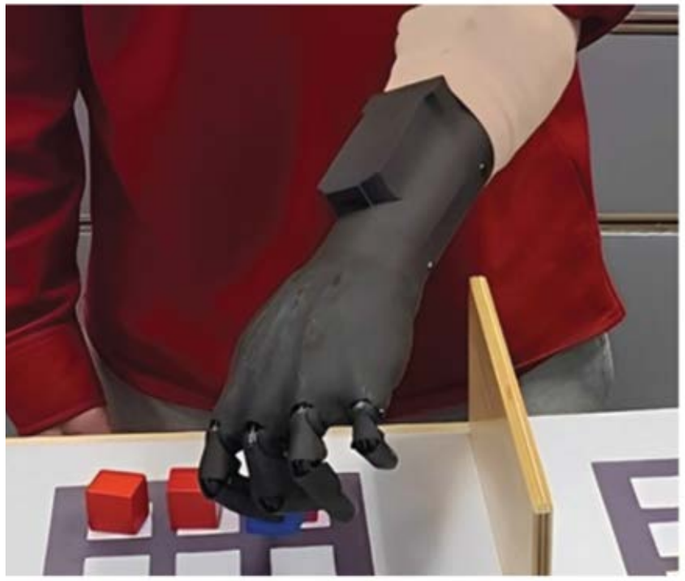
Prof. GUO Hai, Management Committee Member of the Research Institute for Land and Space (RILS), Member of the Research Institute for Sustainable Urban Development (RISUD) and Professor in the Department of Civil and Environmental Engineering, together with global researchers, has conducted a first-of-its-kind study on the effectiveness of green-blue-grey infrastructure (GBGI) in cooling urban heat across various regions. The study findings have been published in the international interdisciplinary journal *The Innovation*.

The study revealed regional and city-specific variations in the effectiveness of GBGI in mitigating urban heat. In Europe, Asia, North America and Australia, the overall cooling effect of GBGI reaches 18.9°C, 17.7°C, 12°C and 9.63°C, respectively. In addition, the implementation of green and blue infrastructure has proven to be highly effective in lowering air temperatures globally. Green infrastructure regulates urban heat through evaporation, transpiration, shading and thermal insulation, while blue infrastructure absorbs heat and cools the surrounding area through evaporation.

The study also demonstrated that various GBGI features noticeably mitigate urban heat in Mainland Chinese cities. The most effective means of cooling include botanical gardens, wetlands, green walls and attenuation ponds, which provide temperature reductions of up to 10°C, 9.27°C, 8°C and 7°C, respectively.

Although the cooling effect ranges are generally similar in the north and south of China, variability was observed within regions. For example, in Beijing, botanical gardens reduce the temperature by up to 10°C, compared to only 2.7°C in Shaanxi province. In Hong Kong, parks, green roofs and golf courses were found to play substantial roles in urban cooling, resulting in temperature reductions of 4.9°C, 4.9°C and 4.2°C, respectively.

RISA develops ProRuka—a novel prosthetic hand controlled by wireless sonomyography

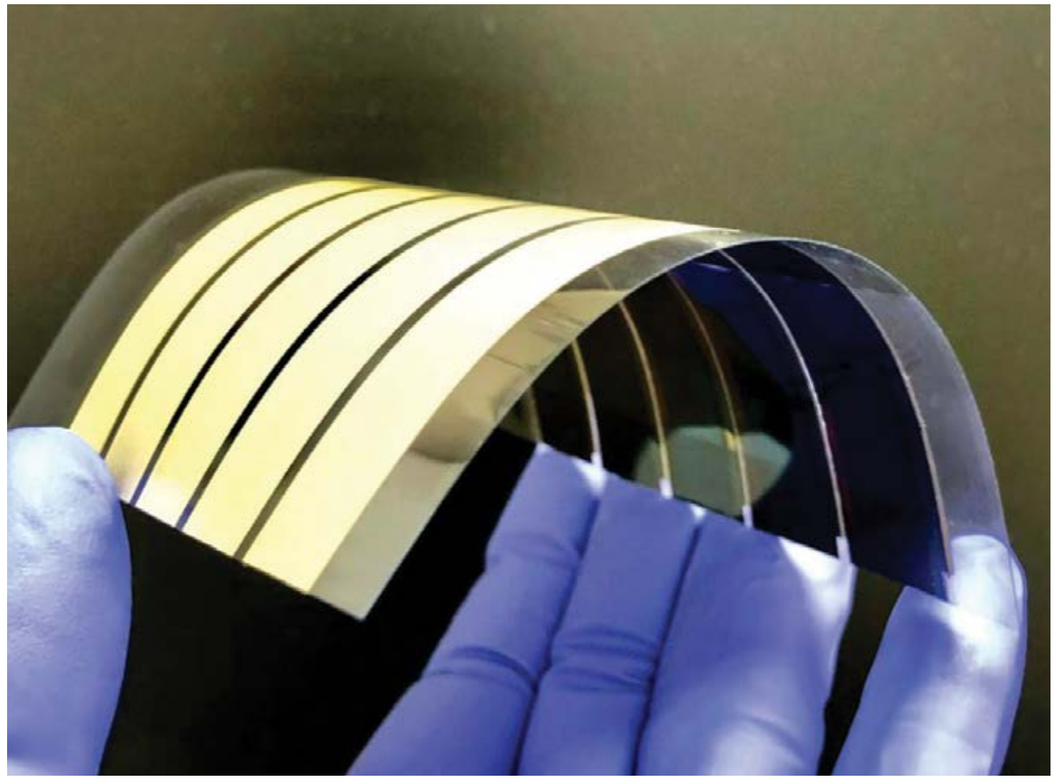


Ir Prof. ZHENG Yongping, Director of the Research Institute for Smart Ageing (RISA), Henry G. Leong Professor in Biomedical Engineering and Chair Professor of the Department of Biomedical Engineering, and his team have developed ProRuka, a novel 3D-printed prosthetic powered hand that can move its fingers independently. ProRuka provides more comfort and mobility for users, enhancing user acceptance and helping users regain quality of life, independence, and confidence.

ProRuka is controlled by stump muscle signals collected by wireless wearable ultrasound imaging known as sonomyography. These signals are analysed by artificial intelligence (AI) algorithms in real time to decode the hand's natural control mechanism. The AI model can also classify a specific hand gesture and the degree of action based on the activation pattern of all muscles combined in the scanning area. ProRuka allows more intuitive control of the prosthetic hand, and can predict more complex hand gestures with higher accuracy, as compared to other available prosthetic hands. It is lightweight and cost-effective, and its mechanical design is based on the natural dimensions and proportions of the human hand.

The invention won the Gold Medal with Congratulations of the Jury and the Special Award from the Taiwan Invention Association at the 49th International Exhibition of Inventions in Geneva, Switzerland.

Flexible perovskite solar modules based on surface reconstruction technology



Prof. YAN Feng, Associate Director of the Research Institute for Intelligent Wearable Systems (RI-IWEAR) and Chair Professor of Organic Electronics in the Department of Applied Physics, developed a flexible perovskite solar module which can conform to a variety of surfaces and shapes. The module is based on surface reconstruction technology that enhances the stability and performance of the perovskite material, thus improving durability and efficiency.

The new solar module has a high power-conversion efficiency that is comparable to the efficiency of traditional solar cells. Its light weight, thinness and flexibility allow easy installation as well as a wide range of applications across industries. The module can be integrated into clothing, backpacks, vehicles and curved building surfaces. The invention will facilitate the increased adoption of solar energy and cost-effective manufacturing of solar modules.

The invention was awarded a Gold Medal at the 49th International Exhibition of Inventions in Geneva.

RCTFF member invents intelligent active-perspiration activewear

Dr SHOU Dahua, Member of the Research Centre of Textiles for Future Fashion (RCTFF), Limin Endowed Young Scholar in Advanced Textiles Technologies and Assistant Professor in the School of Fashion and Textiles, has developed iActive—revolutionary activewear that features artificial sweat glands and a root-like liquid transport system to dissipate sweat quickly and controllably.

iActive creates a breathable and dry skin microclimate by dissipating sweat at a rate that is 3 times faster than the maximum human sweating rate. It also reduces discomfort from post-exercise chills. Users can adjust the sweat level of iActive by means of a smartphone app, thus achieving personalised sweat management and a dry, relaxing workout experience. In addition, iActive is 60% lighter and 50% less clingy when soaked, thus providing the wearer with all-round comfort.

iActive is highly sought after by athletes, sports enthusiasts, construction workers, hyperhidrosis patients and high-performance professionals. The invention was awarded a Gold Medal at the 49th International Exhibition of Inventions in Geneva.

First-of-its-kind multimodal robot for post-stroke ankle-foot telerehabilitation

Dr HU Xiaoling, Member of the Research Institute for Smart Ageing (RISA) and Research Institute for Sports Science and Technology (RISports), has developed the Mobile Ankle-foot Exoneuromusculoskeleton, a one-piece, lightweight wearable system powered by a small rechargeable battery for correcting issues of poststroke footdrop and foot inversion and improving the gait of stroke survivors.

The multimodal wearable robot for ankle-foot rehabilitation integrates the advantages of an exoskeleton, soft pneumatic muscles, tactile sensory feedback and neuromuscular electrical stimulation technology. Powered by Internet of Things (IoT) technology, the device enables telerehabilitation for remote management of patients' rehabilitation progress and allows them to undertake self-help rehabilitation exercises at home. Therapists can remotely monitor the rehabilitation progress of multiple patients. This not only enhances the efficiency and effectiveness of rehabilitation, but also reduces the burden on medical professionals.

The invention won a Gold Medal at the 49th International Exhibition of Inventions in Geneva.

Rhythmic mobilisation device for improving mobility of patients with knee pain

Prof. Amy FU Siu-ngo, Associate Director of the Research Institute for Sports Science and Technology (RISports), Associate Head and Peter Hung Professor in Pain Management in the Department of Rehabilitation Sciences, and her team developed the Patellar Auto-mobilising Device (PAD) for patients with Patellofemoral Pain Syndrome (PFPS).

PFPS is a common knee problem that reduces the mobility of the patella (kneecap). Manual rhythmic mobilisation of the patella can help relieve pain through knee distraction (bone separation) and movement.

PAD consists of an air-sealed kneecup, a mini vacuum pump, a control circuit, an elastic garment suspension mechanism and a rechargeable battery that can automate the process of rhythmic mobilisation. The device is worn on the patient's knee and can be adjusted to create a personalised level of negative pressure that distracts the patellar from the femur (thigh bone). It has various modes for pressure release at different time intervals and under a variety of conditions, and can therefore provide patient comfort in a flexible manner.

PAD was awarded a Gold Medal at the 49th International Exhibition of Inventions in Geneva.

Feature Stories

A dialogue with Prof. Alex MIHAILIDIS, Associate Vice President for International Partnerships at University of Toronto and Scientific Director of AGE-WELL Network of Centres of Excellence

Building an ageing-friendly world empowered by person-centred technologies

Ageing is a natural process, yet many of us fear the unknown. We all want to grow old healthily and live independently in our homes with dignity. As the world's population is ageing at a faster pace than ever before, gerontechnology has become an area of growing interest with an enormous market. Scientists are developing new rehabilitative and assistive technologies for older adults and caregivers. While developers and companies are trying to seize a piece of the pie, it is important that these developments are not driven by a "technology-push", top-down approach.

In this issue, PAIR chats with Prof. Alex MIHAILIDIS, Associate Vice President for International Partnerships and Professor in the Department of Occupational Science and Occupational Therapy at the University of Toronto, about his perspectives on person-centred design in gerontechnology development. Prof. Mihailidis was named in the United Nations' 2021 "Healthy Ageing 50" initiative, which recognises 50 leaders who are making the world a better place in which to grow old.

Multidisciplinary and holistic approach to elder care

Gerontechnology is at the intersection of engineering, science, technology and social sciences. Why is it important that disciplines work together to bring forth new solutions? At PAIR, how can constituent research units focusing on diverse topics collaborate to develop elder care technologies?

When multiple disciplines work together, we can gain a holistic understanding and approach to the issues we are trying to solve. The field of gerontechnology not only involves developing new technologies, but also understanding the underlying social elements. These include end-user needs (i.e., the needs of older people and their caregivers), service delivery (e.g., ways to make these outputs accessible to older people), as well as related polices and regulations (e.g., how these innovations are adopted and whether their applications are supported by governments and agencies). It is essential to bring together the appropriate experts from various fields to provide a comprehensive view of all these factors.

Different disciplines have much to learn from each other. Advances in elder care should be conveyed and applied to other disciplines. At the same time, we can look at the sensors, wearables or artificial intelligence that are currently in use for certain applications and determine whether they can also be employed for elder care.

PolyU is strong in allied health and engineering. This year, the University informed the Hong Kong government of its plan to launch a technology-oriented medical school and "smart hospital" which will be located in the Northern Metropolis to serve students and users from Hong Kong, Mainland China and beyond. Can you provide any thoughts or advice on the school's development?

Allied health professionals such as occupational therapists play an increasingly significant role in determining and providing a range of technologies for older adults. Having a medical school and programmes that integrate traditional medicine, allied health and digital health is a very unique and critical advantage.

At the same time, it is essential to involve industry and service providers from the very start of all these developments. Their participation can help overcome challenges in developing the right kinds of technologies and programmes. They can contribute knowledge about the types of technologies and services that are already available on the market as well as the channels through which to reach the targeted market. Thus, we can ensure that the technology solutions and trainings offered align with real-world needs.

Many aspects of the new school, such as education programmes, service delivery, research and development, talent recruitment, scholarly exchange, etc., must go hand in hand with each other. All these aspects should be given equal emphasis. We cannot focus only on research. This is because the technological development needs to be closely aligned with service delivery models as well as policies and regulations.

In healthcare, there seems to be a knowledge gap between researchers and clinicians. At universities, there seems to be a skill divide between professors of practice/clinical professors and research professors. The former focus on practical instruction of students and patients, while the latter focus on research and academic activities. How can universities better bridge this gap?

It comes back to the importance of conducting research, education and training in a multidisciplinary way, which is not easy to achieve. Researchers, clinicians and practitioners need to be provided with the tools, resources, facilities, and time capacity that will foster collaborations. This really points to the need for training and appointments that provide exposure to research and clinical practices.

Union for a brighter future: Connecting community stakeholders for better elder care

You serve as the Scientific Director of the AGE-WELL Network of Centres of Excellence, Canada's technology and ageing network which brings together a wide range of stakeholders to develop technologies and services for healthy ageing.

In Hong Kong, many universities have already established units dedicated to ageing research. These units have different foci in their studies, covering long-term care policies, interventions, neuroscience, health service management, and so on. What is the value of establishing a formal alliance like AGE-WELL to connect these entities?

PolyU focuses more on research application. By connecting PolyU to other ageing research units in Hong Kong, the universities can achieve stronger outcomes with powerful devices and tools that are accessible to the various communities. Through inter-institutional collaboration, universities can go beyond basic theoretical research, pursuing translational research and achieving practical solutions.

One thing that AGE-WELL is doing very well is that the Network is not funding research projects just for the sake of doing it. The funded projects eventually generate technologies and solutions with a practical impact on the day-to-day lives of older people. AGE-WELL was launched in 2015, and over the past decade we have learnt a lot about how to do research more effectively and how different types of models can be used to bring better research outcomes. This is an area in which AGE-WELL would like to collaborate with PolyU and other partners in Hong Kong. We hope to learn some lessons in terms of how to continue to improve our existing work in Canada.

It is not just about health management: Supporting the diverse needs of elders

At PAIR, you are the Chairman of the International Advisory Committee of the Research Institute for Smart Ageing (RISA). To date, RISA and several other PAIR constituent research units have developed a number of technologies and solutions for older adults. These include an ultrasound imaging technique for liver fibrosis diagnosis; psychological and cognitive interventions that combine music, artificial reality and motion sensors; robotic arms for stroke rehabilitation; microclimate maps for preventing heatstroke in specific neighbourhoods; and a biofeedback system to address freezing of gait in persons with Parkinson's disease.

In addition to our existing work on imaging, interventions and mobility, what other areas could PAIR researchers explore?

Elder care technologies are meant to monitor and support older people. Many other aspects such as socialisation, leisure activities, and civic participation also have a significant impact on the health and wellness of elders. However, few technologies have been developed to address these areas, as compared to the management of disease and health conditions. Hence, more efforts could be directed toward the social needs of elders in addition to the classical focus on health management.

In Hong Kong, the number of suicide cases among the elderly has reached a record high, and there seem to be more cases of family tragedies, i.e., elders being abused by caregivers and attempts of homicide-suicide in older persons. What implications does this situation have for elder care technology?

Technology can be used not only for supporting older adults and their health conditions, but also to address the needs of caregivers including mental health and wellness. Caregivers are often considered as one of the primary groups of customers and end-users of the elder care technologies developed. Hence, developers may also consider technologies addressing caregivers' needs. These can be tools that support their mental health, help them schedule and manage time better, or guide their decision-making.

We are now seeing more technologies being developed to support doctors, nurses and healthcare providers in making clinical decisions in hospitals or other formal settings. Similar technologies should be developed to support decision-making by family caregivers, helping them to make the "best" or the most "sensible" caregiving decisions that take into consideration their own needs as well as the needs of the persons being cared for (based on schedules or lifestyles, for example).

Breaking down the barriers to senior care tech

The global trend to "go digital" is influencing the development of smart elder care technologies which may require end-users to perform certain actions on phones or tablets. To use these technologies, seniors and their caregivers must be digitally literate and have access to smart devices. At the same time, technological development is a profit-making business, and new technologies can be pricey for consumers. In addition, families and senior care organisations may be conservative and resistant to using new technologies. How can developers make sure that their innovations are user-friendly, affordable and trusted by potential users?

One important consideration in development is to keep user friendliness in view during the research process. In other words, developers

should try their best to take a user-centred approach and apply a "design thinking" mindset during the process. They should involve older adults and caregivers in the entire development process. Developers need to understand the needs of seniors and caregivers and their workflows in routine care. We should not develop a technology for the sake of developing, but rather a technology that addresses real-world problems. Therefore, the development should follow a bottom-up approach as opposed to the top-down, technology-push approach.

On the other hand, governments play an important role in ensuring that new products reach their beneficiaries. Governments represent a major stakeholder group, and they benefit from elder care technologies because these innovations can help reduce public spending on healthcare. Hence, governments should provide subsidies and make elder care technology a sector that is attractive to companies. Currently, governments around the world are providing incentives to the automotive industry and other sectors, and they need to do the same with elder care technology.

Another point to note is the provision of education and training on elder care technology. Our society needs to be aware of, understand and embrace the use of technologies in elder care. This requires educating the public from an early stage. For example, providing university and training programmes during which students are taught how technologies can be used in their future fields of work. As a result, when the trained individuals begin their careers, they will already have developed a readiness to employ elder care technologies.

When the researcher becomes the patient: A rehab journey that spurs empathy and motivation

In 2019, you had a serious accident, falling 30 feet from off a cliff. You experienced the rehabilitation system first-hand after a devastating spinal cord injury. Looking back, how would you say this journey has influenced you as a researcher?

It has given me a stronger appreciation for the whole process of technology translation and working more directly with professional healthcare workers and caregivers so that they can understand the role of technology in providing better care.

When I was a patient in the hospital where I am also a scientist, it became very clear to me that the service delivery could be improved, because many of the caregivers in the facility did not even realise that technology was an option for use. This has motivated me to ensure that knowledge translation, knowledge exchange and education are valued equally in any project. They are just as important as the research and development of the technology itself.

Can you share some advice for researchers seeking to excel in the field?

One key piece of advice is to remember not to do development driven by the technology push. It is crucial to understand the needs of the people for whom we are designing. To ensure that the research can achieve impactful outcomes, it is essential to include these users in the research and development process. Also, knowledge exchange is as critical as knowledge translation and should also be incorporated into any project.

A dialogue with Prof. LIN Jianguo, Professor in the Mechanics of Materials Division at Imperial College London, UK

**The interview was conducted in April 2024. The content of this story reflects the development at the time when the interview was conducted. Prof. Lin was appointed as Chair Professor of Materials Technologies in the Department of Industrial and Systems Engineering of PolyU, with effect from 2 September 2024.*

Monetising technology research: The dual-role dilemma and advice for researcher-entrepreneurs

The transfer of knowledge and technology is an important marker of research excellence. Global universities are pursuing science entrepreneurship and industry collaborations more intensely than ever. How should researchers balance their research and commercialisation responsibilities?

In this issue, PAIR Senior Fellow Prof. LIN Jianguo, Professor in the Mechanics of Materials Division at Imperial College London, United Kingdom, shares with PAIR his views on the challenges faced by researchers. The expert in metal forming, materials and process modelling has led his research group to remarkable success in the transfer of manufacturing technologies to industry. The group has established four research centres and two joint research laboratories fully funded by the industry, as well as three spin-off companies that have resulted from their patented techniques.

Good research is the basis of research commercialisation. However, university knowledge transfer differs from technology consulting. Rather than focusing on the present, university researchers strive to address scientific issues of the future, with original, forward-looking solutions.

Finding common language for technical communication in interdisciplinary research

Interdisciplinary research requires professionals from different disciplines to work together. In advanced manufacturing, what disciplines are involved in addition to engineering? What are the keys to synergistic success?

First and foremost, we need individuals who are keen to do interdisciplinary research and share a common interest. Interdisciplinary research is particularly important for senior staff and chair professors with a clear vision and the scope to do something new that cannot be achieved through a single disciplinary approach.

In manufacturing, mechanical engineers often need to collaborate with material scientists for the characterisation of microstructures during the development and manufacturing of novel materials. In recent years, advanced technologies including automation, artificial intelligence (AI), and big data have become increasingly important. As such, we also collaborate with computer scientists in incorporating AI and machine learning technologies into manufacturing systems, as well as mathematicians and statisticians who work on data and analytics that enable automation and software functions.

Second, having common knowledge and languages among collaborators from different disciplines is important for effective communication. We not only need to close the knowledge gap between disciplines; we must also have a knowledge overlap to enhance communication and understanding. My expertise is in manufacturing, but I do need to possess some knowledge about mathematics, data science, computer programming, etc., so that it is easier for me to communicate and collaborate with peers. Having a common language is important for mutual understanding. People from different disciplines need to have a clear idea of the goals in their research roles and the kinds of resources required to achieve advanced, value-added manufacturing technologies.

Towards high value-added manufacturing and the future of work

High-value added advanced manufacturing is a key focus in the Nation's Greater Bay Area (GBA) development. The GBA strategy aims to connect and combine the strengths of Mainland China and Hong Kong in manufacturing as well as innovation and technology, and seeks to include neighbouring cities with a view to establishing the Bay Area as an internationally competitive region. How does high value-added manufacturing differ from traditional manufacturing?

Manufacturing has changed significantly in the last 50 years. In the past, manufacturing was about mass production, that is, repeatedly producing the same products. Factories back then had a large number of workers sitting at assembly lines and performing manual labour. Nowadays, in value-added manufacturing, we apply new disciplines and technologies like AI, machine learning and data analytics to automate production processes and produce customised goods. Modern factories only require a small team who can look at computer screens to monitor all production processes. In some cases, we do not even need anyone to do the monitoring work, as the manufacturing systems can even alert us in the case of failures or issues that need to be fixed. Thus, modern manufacturing requires a smaller workforce and is less labour intensive. Automation is becoming more important than ever before, especially as labour costs continue to increase.

How does automation shape the future of work in manufacturing and related fields?

The labour force, in my opinion, will witness a transfer of human capital from areas like factories to certain fields, particularly research and development. We need people who can write software, generate new ideas and develop products, as well as those who can do product testing and marketing. The frontline production does not require as many people as before, but the backend operations need to be supported by highly educated people. I think Hong Kong has a competitive advantage in talent attraction.

This does not mean that all traditionally competitive jobs will be removed and replaced by new technologies. Take healthcare as an example: society still needs physicians and doctors for clinical work, but hospitals will probably need more researchers and developers who can look into the systems used in healthcare, identify functions that can be performed by AI, and conduct relevant research and development.

Global race for research talents in higher education

Global universities, particularly research-intensive ones, are now in a competition for talented scientific researchers. What can be done by universities to better attract and retain these talents?

An inclusive international university ecosystem is important. This is because distinguished, high-level scholars coming from different countries can learn from each other and also attract more talents. Next, universities need to proactively send representatives, preferably influential figures and academics, to visit various places around the world to recruit talented researchers.

In my capacity as the Head of the Mechanics of Materials Division at Imperial College, I put great effort into joining international conferences, meeting peers, building networks and inviting top scholars to join the College. Universities would win top talents more easily if they let academics know whether they could bring their teams to work at the new location and explained how to initiate activities to open up a new research area.

Technologies ready for take-off? Find your market niche.

At PAIR, the Research Institute for Advanced Manufacturing (RIAM) has successfully created a strong, ductile and sustainable titanium alloy (α–β Ti-O-Fe alloy) using a 3D printing method that recycles off-grade sponge titanium. The study was published in Nature. What are your views on how RIAM can bring this success to the next level?

First and foremost, we need to ensure that there is a market for the new alloy; that is, we must have a business plan identifying the potential applications and possible competitive materials that could be used as replacements. Each metal has its own advantages and disadvantages. Titanium is lightweight, but its production cost is usually high.

In my opinion, given the strength and ductility of the RIAM-developed alloy, the team might consider cold stamping (i.e., shaping metal at room temperature) for the material, and this would become a huge aerospace application with a big market. Currently, the use of near-isothermal hot stamping techniques for titanium alloy faces many issues and is very expensive.

Another potential application for this piece of RIAM work is to produce preforms using 3D printing for this alloy, and then forge them into components such as gas turbine blades. These blades are normally difficult to manufacture due to the complex shapes of their preforms. If the team is able to use 3D printing to optimise the shape of preforms easily and at lower cost, then hot forging could minimise the defects of 3D printing. Furthermore, modifying the microstructure to improve the mechanical properties of forged components would make the final products really competitive.

Choosing the right industry collaboration for scientific endeavours

University researchers may be approached by industries seeking technical solutions. What are some considerations including intellectual property (IP) right concerns that researchers should take in determining whether to take up these university-industry collaboration opportunities or to commercialise the technologies by themselves?

The central role of a university researcher is to conduct scientific studies. Personally, I would prefer undertaking industry collaborations that bear scientific value, i.e., those that address not only industrial problems but also scientific challenges for the longer term.

However, this is not easy because industry and academia differ by nature. University research groups are not like consulting companies. We focus on scientific issues, not business problems. In deciding which collaborations to take on, researchers should really think very carefully about the kind of work we would like to do. Industries tend to focus on problems in the short term, and they cannot wait a long time for the technology output from universities. By contrast, academia focuses on problems in the medium and longer term, although larger companies may also think for the future. The support that researchers receive from businesses depends on the size of those companies. Small companies cannot afford to provide large amounts of funding for universities to carry out original, fundamental research that takes years of development. Industries tend not to support very original university work due to potential failure.

Very often, the research projects which we undertake for fundamental research and for industry are of different technology readiness levels (TRL). Technology readiness refers to the maturity of technology at different stages of research and development. There are nine levels in total, with 1 being original, basic research and 9 being technologies that are already in full commercial application. Our projects supported by government funding (for example, from the Engineering and Physical Sciences Research Council in the UK) mainly focus on original ideas (e.g., TRL 1). The research council supports projects on new ideas that may fail. On the other hand, our collaborative projects with the companies normally start from TRL 3–4, and then we push further to TRL 5–7, since the industries expect fairly good results and cannot accommodate failures to the same extent.

Innovations taking off: Collaborative input from research, management and marketing professionals

Academics focus on scientific research and do not have much time, resources or experience for industrial activities. How can universities better support their industry engagement and research commercialisation?

As a professor, I have expertise in scientific research on technical difficulties, not in marketing nor in running a company. Therefore, we need to recruit the appropriate individuals to create start-up business plans. Hence, it would be very helpful if universities had designated organisations or offices that could evaluate these opportunities, provide a bit of funding support, recruit professionals with business, commercial and marketing backgrounds to formulate a business proposal in about three to nine months, and form a committee to assess the feasibility of the business plan. This would help researchers better understand the competitiveness of their innovations, the lead time for technology launch, and the size of the investment needed for pushing these technologies into the market. If an innovation does not have a huge market, entails a high cost, or requires a large investment, then the plan may not be viable, and sometimes researchers have to give it up or take a step back and continue to improve the technology.

Quality research comes first

Can you give some advice to researchers who also have roles in spin-off companies, and young researchers aspiring for success in knowledge transfer?

My strong advice to academics is to always balance their time. They can probably spend 20%, but no more than 50%, of their time on commercialisation, in my opinion. Spending too much time on it could eventually affect their scientific work. As academics, our main duties are to teach and research.

In regard to young researchers, they need time to concentrate on a research area, accumulate knowledge about it, develop certain attitudes, and generate ideas until they reach the point where they are fully equipped to pursue research commercialisation. If they are aiming primarily for research commercialisation, then the business sector would probably be more suitable to them, rather than a university.

The international reputation of academics in research and teaching is the cornerstone of university success. Universities often receive money from governments, student fees, research funding and other sources, and therefore institutions should not rely too heavily on university spin-offs for generating income. This is because most spin-off companies in their initial phases are usually short of cash.

In regard to researchers who are exploring start-up opportunities, they should be attentive to the dynamics of research investment. This is because researchers may have less control over their own technology start-ups after receiving venture capital. The investors may draw the researchers away if the researchers' academic engagements and publication activities interfere with the commercialisation and business profit. Thus, there are both good and bad sides of commercialisation.

In addition, researchers should assess the level of university support available to them and examine the feasibility of founding start-ups. One consideration is sabbatical leave arrangements. There are some researchers who spend too much time working on their companies and have no time for research and publications, and as a result they have to leave their university jobs. In most cases, however, researchers take a year out to help launch the company at the critical stage, and then return to their academic positions.

Optimising manufacturing and supply chain logistics through better decision-making

Decision science, an interdisciplinary field that draws on disciplines including economics, statistics, computing, engineering, machine learning, psychology and management sciences, is concerned with analysing various types of information to enable better decision-making.

Industry 4.0 (I4.0) signals massive changes in the supply chain and manufacturing landscapes. Disruptive technologies for connectivity, analytics, human-machine interaction and advanced engineering have enabled a range of decision science solutions that help manufacturing and supply chain operations to "go smart".
In this issue, PAIR discusses with Prof. George Q. HUANG, Director of the Research Institute for Advanced Manufacturing (RIAM) and Chair Professor of Smart Manufacturing, the ways in which industries benefit from technology transitions. Prof. Huang is an expert in smart manufacturing and logistics, the cyber-physical internet, and systems analytics. In May 2024, he was appointed as the new director of RIAM, leading the Institute in its pursuit of interdisciplinary research on advanced manufacturing solutions.

iFactories: The promise of smart manufacturing from hardware and software perspectives

Intelligent factories, also known as "iFactories", utilise various technologies to improve productivity, efficiency, flexibility and decision-making in manufacturing and supply chain operations. Just as computers are composed of physical parts and computer processor chips that set operations, iFactories are built and assembled with hardware and software components. However, what gives these factories intelligence are "digital twins", which provide virtual replications of the manufacturing processes or behaviours, so that operators can monitor the processes in real time and take corresponding actions.

"iFactories include a formal computer architecture and operating system. In the iFactory architecture, the digital twins of different manufacturing resources are used in constructing iFactories' central processing units (CPUs) and processors. This iFactory architecture makes all physical aspects of the manufacturing process 'visible' and 'traceable', in terms of both space and time," Prof. Huang explained. Such visibility and traceability in manufacturing is vital

for operators and managers in their decisions about factory operations, planning, scheduling and execution.

The next question is how to make manufacturing "visible" and "traceable". This necessitates the cyber-physical internet (CPI) and system analytics. CPI is a network system that allows organisation users to track materials, goods and equipment in real time, ensure timely delivery, and reduce disruptions. System analytics is a technology for analysing business procedures and processes, and identifying and suggesting improvements.

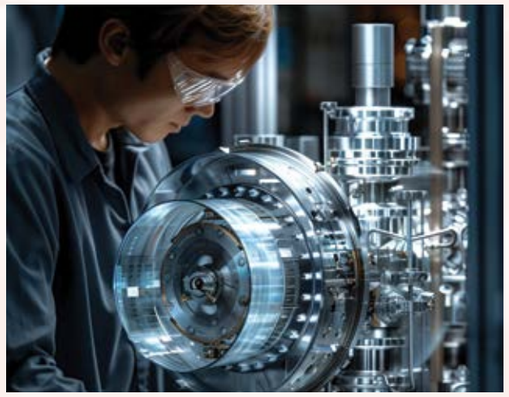
In supply chain management, small changes in demand can produce large swings in production. Such "bull-whip" effects can be addressed through CPI solutions, so that operators can avoid keeping excess inventory and using expensive warehouse space.

Achieving mass customisable production in cellular manufacturing

In manufacturing, line production is a mass production process in which the machines and workers carry out repetitive, monotonous tasks or operations in a pre-defined sequence to assemble a product that moves along the conveyor belt for further assembly until the finished product is configured. Cellular manufacturing, by contrast, involves "work stations" or "cells", where various parts and tools are placed closer to the workers so that they can perform multiple tasks in assembling a product from start to finish. This enables the production of a wider variety of goods.

Cellular manufacturing has the advantages of boosting employee morale and supporting mass customisation, as compared to line production. However, the environment in cellular manufacturing is loaded with variables and uncertainties. Producing customisable goods means customer orders are highly diverse. Different work stations may become out of sync, as some cells may work faster than others, hence creating the problem of heterogeneous demand–capacity synchronisation (HDCS).

Prof. Huang and his team are determined to remove this bottleneck by devising solutions that help coordinate the heterogeneous capacities in the assembly cell lines in a complex manufacturing environment. The team developed a Graduation Intelligent Manufacturing System (GiMS) using artificial intelligence-enabled internet of things (AIoT) technologies and an "out of order execution" (OoOE) algorithm.



"The AIoT-enabled GiMS obtains real-time information on production status and progress, uses AI technologies to improve the dimension and granularity of the information acquired, and conducts analyses on the production capacities of individualised assembly cells using computer vision and machine learning," Prof. Huang told us. "In this way, the heterogeneous capacity of different assembly cells can be coordinated to meet the heterogeneous customer demands effectively and efficiently, while optimising the synchronisation of production operation and management."

The system was tested at an electronics company which develops and produces servo motors and drivers, and it significantly improved the company's shipment punctuality and production efficiency.

More than efficiency: Putting people at the heart of the manufacturing business

The paradigm shift to smart manufacturing is about making industry not only more productive, but also more sustainable. In other words, greater value is placed on human well-being at the centre of the production process, hence making the industry more human-centric, resilient and sustainable.

Implementing ergonomics in industry is essential for creating a work environment that enhances well-being and performance. For example, work stations can be designed in a way that encourages workers to maintain good posture, thus reducing their risk of injury.

Prof. Huang and his team have developed a human-machine work system (HMWS) for proactive ergonomic risk mitigation (PERM). The smart system supports real-time data-driven human-machine synchronisation (RHYTHMS). To test the system's performance, the team built an experimental prototype and tested it at a company that produces a wide variety of motors and motor drivers in small quantities (high-variety, low-volume production).

"The prototype integrates I4.0 enabling technologies to assist human workers in improving overall performance," Prof. Huang explained. "The prototype includes a camera module on the top of the work station, which is used to capture and analyse operational status and processes in real time. The real-time anthropometric data is then used to construct a hyper human model, and is analysed to calculate the distances between different joints of the worker's body. Based on the results, the racks of the machine rotate into accessible, desired positions so that the worker can easily select the needed components for assembly, hence helping to reduce workload and mitigate ergonomic risks."

Supporting the Greater Bay Area's development into a global hub for advanced manufacturing and modern service industries

From intelligent manufacturing system to human-machine synchronisation, the work by Prof. Huang and his team has demonstrated how technologies and complex data can be applied to bring forth smart decision science solutions that improve people's lives and societal development.

"Informatisation has brought us new opportunities. The vast amount of data collected can make the information environment complex. But such complexity is not what we ultimately hope to achieve. Our genuine purpose should be to leverage the power of traceable, transparent real-time data in developing decision-making models that help promote the development of industries," Prof. Huang said.

To him, the Nation's Greater Bay Area (GBA) development stands out as a golden opportunity for research development, especially for innovations targeted at the manufacturing and logistics fields. Many practices in traditional mass manufacturing in the past may have been borrowed from, and made reference to, other countries and systems. This approach does not help achieve the Nation's ambitious vision for GBA and smart manufacturing. Now is the prime time for researchers to make their contributions.

"The GBA is a base for informatisation. Strong manufacturing and logistics can drive developments in the modern service industries and financial industry. Researchers and developers in the field of decision science must develop related decision-making models with Chinese characteristics for the development of the GBA and industries," Prof. Huang said.

Cyber-physical internet for synchronising cross-border logistics hubs in the Greater Bay Area

Prof. Huang is now leading a large project which aims to build a CPI called "SynchronHub" for the GBA. "CPI is an emerging system which involves 'digitising the physical' and 'physicalising the digital'. We can say that CPI is a logistics system in the metaverse, or a concept which uses metaverse technology to solve logistics problems in the physical world," he explained.

To do so, Prof. Huang and his interdisciplinary research team from PolyU and The University of Hong Kong, as well as partners from Jinan University, Shenzhen University, logistics business associations and leading companies in the GBA, are engaged in collaborative research on CPI. The developers are focusing on various components including digitisation technologies, network services and mechanisms. The resulting SynchronHub will provide decision support for synchronised logistics planning, scheduling and execution. It is hoped that with the new CPI, sending and receiving goods will become just like sending and receiving messages within chat groups using instant messaging platforms.

Leading PolyU interdisciplinary advanced manufacturing research to reach new heights

In May 2024, Prof. Huang was appointed as the new Director of the Research Institute for Advanced Manufacturing (RIAM). The Institute brings together PolyU researchers from different faculties, schools and departments for interdisciplinary research to develop advanced manufacturing solutions and industrial collaborations to put these solutions into real-world application.

"At RIAM, we shall continue our efforts and carry the RIAM torch forward to the next stage of achievements. Our vision is to establish a hub at PolyU for world-class manufacturing research and knowledge transfer to contribute to economic growth in a global context", said Prof. Huang. "RIAM plans to support and nurture colleagues as they build and enhance critical masses for strategic research programmes with high impact, and to work together with international centres of excellence and industrial leaders to establish a global network of excellence in advanced research".

Currently, he has initiated and is leading an RIAM project to build a large model for fashion product customisation and social manufacturing. The project combines the disciplines of mass customisation, social manufacturing, computer vision, cognitive science, large language models, and cyber-physical networking for the sake of high-performance production planning, scheduling and execution.

"Smart manufacturing requires new ways of thinking and operations to deliver intended breakthroughs. Putting together all the advanced technologies in a factory may not be necessary nor sufficient. Instead, it is imperative for multiple disciplines and key stakeholders in the supply chain to collaborate closely to innovate new processes, decision models and facilities," Prof. Huang said.

People

PolyU research projects receive funding from RAISe+ Scheme

The Innovation and Technology Commission of the HKSAR government announced the first batch of approved projects under the Research, Academic and Industry Sectors One-plus (RAISe+) Scheme on 28 May 2024. The scheme aims to provide funding, on a matching basis, for at least 100 research teams from universities funded by the University Grants Committee which demonstrate strong potential to evolve into successful startups. Each approved project will receive funding support ranging from HK$10 million to HK$100 million.

Two research projects led by PAIR members are among the first batch of 24 projects selected under the scheme.

Project Title
Energy-Efficient Liquid Cooling System for Data Centres

Project Leader
Prof. WANG Zuankai
Associate Vice President (Research and Innovation), Kuok Group Professor in Nature-Inspired Engineering, Chair Professor of Nature-Inspired Engineering of the Department of Mechanical Engineering, and Member of the Research Institute for Intelligent Wearable Systems (RI-IWEAR) and the Research Institute for Sports Science and Technology (RISports)

Project Title
Pilot and Mass Production of Next-Generation Composite Current Collectors for Mobility and Energy Storage Batteries

Project Leader
Prof. ZHENG Zijian
Chair Professor of Soft Materials and Devices, Professor in the Department of Applied Biology and Chemical Technology, Associate Director of RI-IWEAR, Management Committee Member of the Otto Poon Charitable Foundation Research Institute for Smart Energy (RISE), and Member of the Research Institute for Artificial Intelligence of Things (RIAIoT), the Photonics Research Institute (PRI) and the Research Institute for Sustainable Urban Development (RISUD)

PAIR scholar receives SME Outstanding Young Manufacturing Engineer Award

Congratulations to Dr ZHENG Pai, Member of the Research Institute for Advanced Manufacturing (RIAM), Wong Tit Shing Young Scholar in Smart Robotics and Assistant Professor in the Department of Industrial and Systems Engineering, for being honoured with the 2024 Outstanding Young Manufacturing Engineer Award by the Society of Manufacturing Engineers (SME). The award recognises manufacturing engineers aged 35 or younger for exceptional contributions and accomplishments in the manufacturing industry.

Dr Zheng's research is at the frontier of the fields of smart manufacturing and robotic systems, and focuses on human-robot collaboration, smart product-service systems, and engineering design informatics. The inventions he developed have been patented and licensed for translation into practical applications, making significant contributions to the industry.

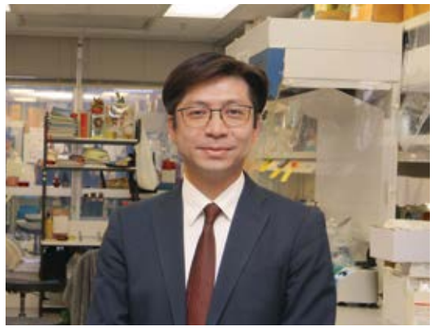
RILS scholars win two Smart Living Partnership Awards 2023/24

Congratulations to Prof. DING Xiaoli, Director of the Research Institute for Land and Space (RILS), and Dr Wallace LAI, Core Member of RILS, for winning the awards "Outstanding Land Subsidence Monitoring Technology by Integrating Satellite Remote Sensing & Mobile Surveying" and "Outstanding Imaging Technologies for Rapid Leakage Diagnosis of High-Pressure and Large Water Mains", respectively, in the Smart Building / Environmental Technology / Green Technology category of the Smart Living Partnership Awards 2023/24.

Co-organised by ETNet and Hong Kong Cyberport, the awards aim to recognise, promote and support outstanding companies or organisations which demonstrate commitment to promoting Hong Kong as a smart city, improving our society's competitiveness and increasing public awareness of digitalisation.

Two PAIR members honoured by the Government of the HKSAR

Congratulations to Prof. WONG Ka-hing and Ir Prof. Albert CHAN Ping-chuen for being recognised in the 2024 Honours List published by the Government of the Hong Kong Special Administrative Region (HKSAR) on 1 July 2024. The presentation ceremony for the awards will be held later this year.



Prof. WONG Ka-hing, Director of the Research Institute for Future Food (RiFood) and Professor in the Department of Food Science and Nutrition, will be awarded the Chief Executive's Commendation for Community Service in recognition of his contributions in promoting the sustainable development of the fisheries industry in Hong Kong.

Ir Prof. Albert CHAN Ping-chuen, Associate Director of the Research Institute for Sustainable Urban Development (RISUD), Dean of Students, Able Professor in Construction Health and Safety and Chair Professor of Construction Engineering and Management, will receive the Medal of Honour in recognition of his contributions in construction policy research and in nurturing young talents to join the construction industry.

PolyU recognises two PAIR members with PolyU Young Innovative Researcher Award 2024

Congratulations to the following two young talents at PAIR for winning the PolyU Young Innovative Researcher Award (YIRA) 2024!

YIRA aims to honour PolyU researchers under the age of 35 who have demonstrated novelty, contributed to technological advancement, and propelled transformative innovations to address societal problems. Each awardee will receive research funding support of HK$500,000 and a personal cash prize of HK$20,000.

Awardee
Dr HUANG Dongmei

PAIR Research Unit
Photonics Research Institute (PRI)

Research Focus
High-performance swept laser and its applications

Awardee
Dr LI Tian

PAIR Research Unit
Research Institute for Future Food (RiFood); Research Institute for Intelligent Wearable Systems (RI-IWEAR)

Research Focus
Contrast-adaptive real-time (CART) 4D-MRI technique via cascaded deep learning for abdominal tumour tracking in MRI-guided radiotherapy

Five PAIR members shine at PolyU's inaugural Patents Achievement Award

The PolyU Patents Achievement Award was launched this year in appreciation and recognition of the remarkable achievements of departments and inventors that are actively engaged in intellectual property (IP) filing. The scheme includes two categories of award. The "Top Patents Filing Award" considers IP filing activities over the past five years, while the "Most Active Patents Filing Award" focuses on IP filing activities within the award year. The recipients of the inaugural award have been announced.

Congratulations to five PAIR members for winning the PolyU Patents Achievement Award 2023! Three members, Prof. Benny CHEUNG Chi-fai, Associate Director of the Research Centre for SHARP Vision (RCSV), Prof. John SHI Wenzhong, Director of the Otto Poon Charitable Foundation Smart Cities Research Institute (SCRI), and Prof. TO Chi-ho, Member of RCSV, won the "Top Patents Filing Award". Two members, Ir Prof. POON Chi-sun, Director of the Research Centre for Resources Engineering towards Carbon Neutrality (RCRE), and Ir Prof. ZHENG Yongping, Director of the Research Institute for Smart Ageing (RISA), won the "Most Active Patents Filing Award".

Prof. LENG Zhen awarded ACSE's 2024 Walter L. Huber Civil Engineering Research Prize

Prof. LENG Zhen, Associate Director of the Research Centre for Resources Engineering for Carbon Neutrality (RCRE) and Member of the Research Institute for Land and Space (RILS) and the Research Institute for Sustainable Urban Development (RISUD), received the 2024 Walter L. Huber Civil Engineering Research Prize (Huber Award) from the American Society of Civil Engineers (ASCE) for his innovative research on durable, low-carbon, cost-effective pavement materials and technologies.

The Huber Award is the highest-level mid-career research award given annually to individuals with notable achievements and contributions in research with respect to all disciplines of civil engineering.

Prof. ZHANG Weixiong appointed as Associate Director of PAIR

We are pleased to announce that Prof. ZHANG Weixiong, Chair Professor in Bioinformatics and Integrative Genomics in the Department of Health Technology and Informatics, has been appointed as Associate Director of PAIR, effective 1 August 2024.

Prof. Zhang is a Global STEM Scholar under the Global STEM Professorship of the HKSAR government. He is an expert in medical laboratory science, and his research interests include genetics/genomics, non-coding RNA, medical imaging, etiology and biomarkers, big data analytics and artificial intelligence. Prof. Zhang received his PhD in computer science from the University of California, Los Angeles, U.S.A. Before joining PolyU, he was a Professor in the Computer Science and Genetics Departments at Washington University in St. Louis, USA.

News & Events

Prof. YUNG Kai-leung attends Reception for I&T Awards 2024 hosted by HKSAR Government

The Innovation and Technology Commission of the HKSAR organised the Reception for I&T Awards 2024, themed "Hong Kong's Innovation and Technology Achievements Shine in International Arena", on 15 July. The event recognised the outstanding research and development (R&D) achievements of Hong Kong's talent in the field of innovation and technology (I&T) on the Mainland and overseas in the past year. The reception drew more than 300 representatives from the local I&T sector, including academics, scientists, and representatives of institutes and government departments. They were commended for bringing glory to the region by showcasing Hong Kong's I&T strengths and telling Hong Kong's excellent stories to the world.

Ir Prof. YUNG Kai-leung, Sir Sze-yuen Chung Professor in Precision Engineering and Director of the Research Centre for Deep Space Explorations (RCDSE), was among the scientists attending the reception, which was one of many events celebrating the 75th anniversary of the founding of the People's Republic of China and the 27th anniversary of the establishment of the HKSAR. At the reception, Prof. Yung was acknowledged for his significant contributions to the Nation. He led a space instruments development team as it participated in various national space missions, including developing and manufacturing the "Surface Sampling and Packing System" for Chang'e-6 to assist the Nation in completing the world's first lunar far-side sampling mission.

PolyU co-organises Micro Flow and Interfacial Phenomena Conference (μFIP) 2024

The Micro Flow and Interfacial Phenomena Conference 2024 (μFIP 2024) was successfully held at PolyU from 21 to 24 June. The conference brought together academic, research and industry communities in the fields of thermodynamics, fluidics, bio-chemical and bio-medical engineering, and microfluidics for interdisciplinary exchange with a focus on energy applications involving microchannel flow or microscale surface phenomena.

The first day of the conference featured plenary presentations by seven distinguished scientists from around the world, including Prof. Sir Andre GEIM, Winner of the 2010 Nobel Prize in Physics and Regius Professor at the University of Manchester, as well as esteemed members of the Chinese Academy of Sciences, National Academy of Sciences, and National Academy of Engineering. The speakers were warmly received by PolyU representatives, including Dr LAM Tai Fai, Council Chairman; Prof. TENG Jin-Guang, President; Prof. Christopher CHAO, Vice President (Research and Innovation); Prof. WANG Zuankai, Associate Vice President (Research and Innovation) and Conference Chair; Dr Laura LO, Associate Vice President (Institutional Advancement); Prof. CHEN Qingyan, Director of PolyU Academy for Interdisciplinary Research; and the central management team of the University.

The seven plenary sessions served as part of the PAIR Distinguished Lecture Series and received very positive responses, attracting more than 300 participants in person and capturing an online viewing audience of over 24,900 from different countries and regions for the live broadcast on multiple social media platforms, including Bilibili, WeChat, Weibo and YouTube.

Prof. LENG Jinsong of Harbin Institute of Technology delivers PAIR seminar on shape memory polymer composites

Prof. LENG Jinsong, Dean of the School of Future Technology, Director of the Centre for Smart Materials and Structures (CSMS), Director of the International Center for Applied Mechanics at Harbin Institute of Technology (HIT), China, and Deputy Director of the Academic Committee of HIT, delivered the PAIR seminar titled "Shape Memory Polymer Composites: Programmability, 4D Printing and Applications" on 15 July 2024. The seminar attracted more than 90 participants in person and captured an online viewing audience of over 12,500 who watched the live broadcast on multiple social media platforms, including Bilibili, WeChat and Weibo.

Prof. HUANG Yonggang of Northwestern delivers lecture on shape programmable 3D mesostructures and functional devices

Prof. HUANG Yonggang, Jan and Marcia Achenbach Professor of Mechanical Engineering, Civil and Environmental Engineering, and Materials Science and Engineering at Northwestern University in the United States, delivered the 28th PAIR Distinguished Lecture titled "Shape Programmable Three-Dimensional Mesostructures and Functional Devices" on 8 August 2024 at PolyU. The lecture attracted more than 100 participants to join in person and captivated an online viewing audience of over 15,500 from different countries and regions to watch the live broadcast on multiple social media platforms, including Bilibili, WeChat, Weibo, YouTube, etc.

RISports and Diocesan Girls' School establish AI Swimtech Laboratory to enhance swimmers' performance

The Research Institute for Sports Science and Technology (RISports) and Diocesan Girls' School (DGS) have entered into a Memorandum of Understanding to jointly establish the "PolyU–DGS AI Swimtech Laboratory" to catalyse research in the fields of sports science and technology.

The agreement was signed by Prof. ZHANG Ming, Director of RISports, Head of the Department of Biomedical Engineering and Chair Professor of Biomechanics, and Mrs Stella LAU, Headmistress of DGS. Under the agreement, DGS will provide swimming facilities at which PolyU researchers will install equipment for data collection. DGS will also arrange the participation of student swimmers in a research trial.

This collaboration aims to strengthen research on enhancing elite athletes' performance and boost talent identification by more fully unleashing the athletes' potential, with the long-term goal of maximising athletic performance at the school level and nurturing more outstanding swimmers.

Establishment of Research Institute for Quantum Technology

We are pleased to announce the establishment of the Research Institute for Quantum Technology (RIQT) with effect from 1 September 2024 as one of the constituent research units of PAIR!

RIQT aims to establish PolyU as a leading multidisciplinary research institute in quantum technology and microelectronics, a rapidly growing cutting-edge research area that integrates quantum physics, computer science, mathematics, microelectronics and photonics.

Prof. LIU Ai-Qun, Chair Professor of Quantum Engineering and Science of the Department of Electrical and Electronic Engineering (EEE), will lead the Institute as RIQT Director. Prof. Johan F. HOORN, Professor in the Department of Computing, Prof. MAK Man-wai, Professor in the EEE Department, and Prof. ZHANG Xuming, Associate Head and Professor of the Department of Applied Physics, will serve as RIQT Associate Directors.

Prof. David PUI of UMinnesota to deliver lecture on green technologies for sustainable environment

PAIR cordially invites you to join our Distinguished Lecture on 13 September 2024 (Friday) at 2:30pm–4:00pm (Hong Kong time) on PolyU campus. The lecture titled "Green Technologies Development for Sustainable Environment" will be delivered by Prof. David PUI You-hong, Regents Professor and LM Fingerson/TSI Inc. Chair in Mechanical Engineering, University of Minnesota, United States.

Registration: https://www.polyu.edu.hk/pair/news-and-events/upcoming-events/2024/9/20240913-pair-dls-by-prof-david-pui/

PolyU partners with Times Higher Education to organise THE Global AI Forum on campus

In partnership with Times Higher Education (THE), The Hong Kong Polytechnic University (PolyU) is co-organising the THE Global AI Forum on 29 November 2024 on the PolyU campus. The Forum will bring together leading academics, researchers and thought leaders working in AI to share and discuss the latest developments in AI ethics, horizons and the impact on universities. This unmissable event will give higher education leaders the opportunity to connect with peers and support institutional growth as we enter a new era of AI in education.

Find out more about the Forum on the official website: https://www.timeshighered-events.com/global-ai-forum-2024/home