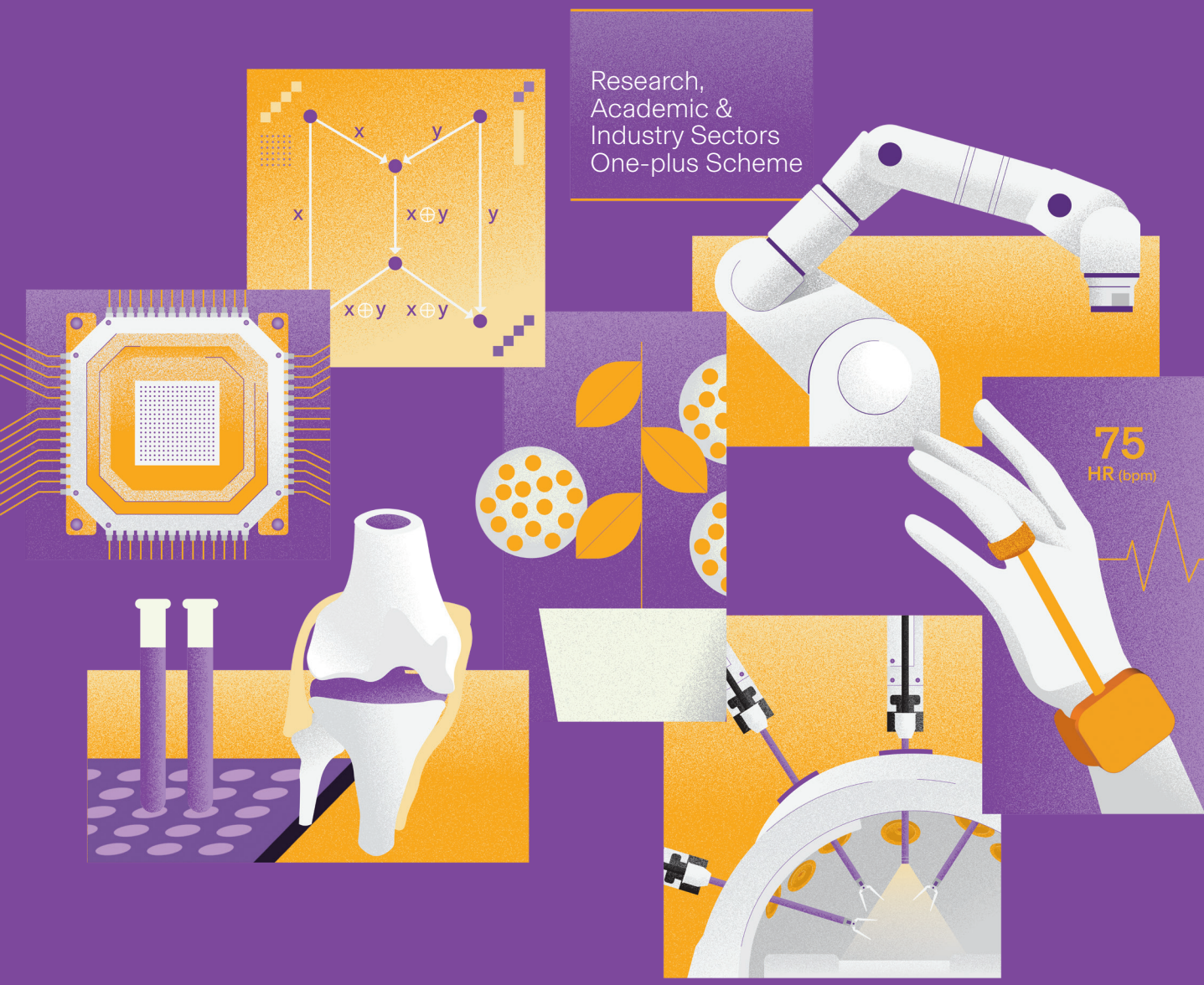
Chinese University

BULLETIN

RAISe the bar for research

No.2, 2024



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Contents

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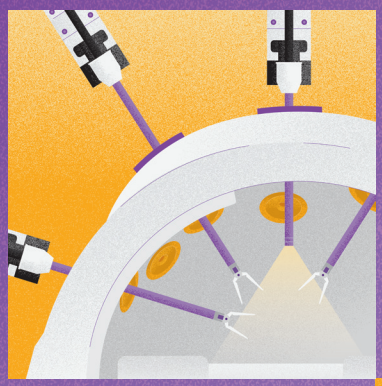
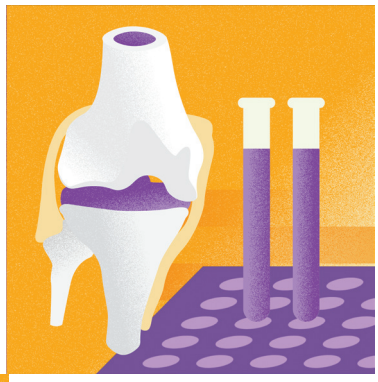
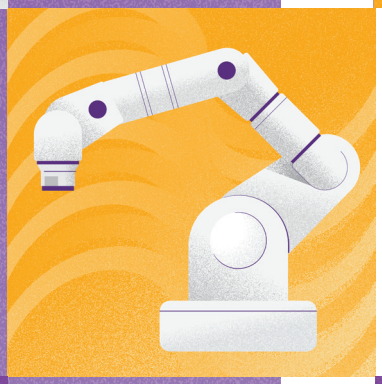
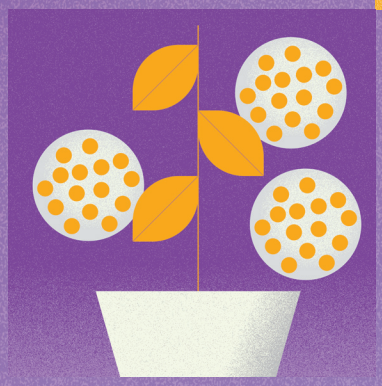
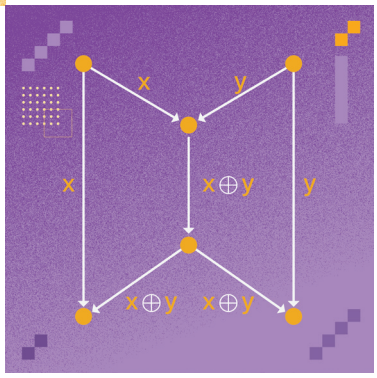
Raising the bar for research

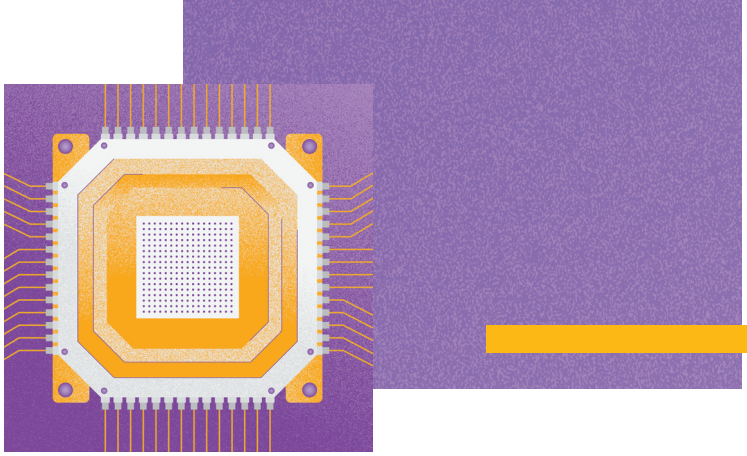






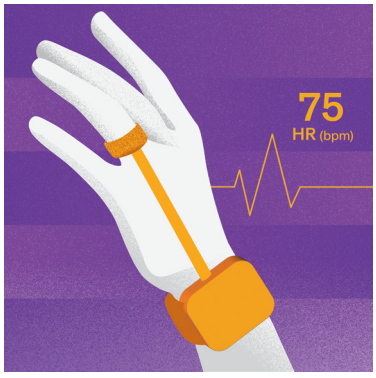






In the past 60 years, CUHK has grown from a campus on the barren hills of Shatin to an internationally renowned university. Along the way, it has gained acclaim as a world-class institution, providing a base for generations of academics all hoping to benefit humankind with the results of their research. As it embarks on its seventh decade, the University finds itself ready to deal with the latest technological trends, and eager to continue generating positive societal impact.

For the second issue of our *Bulletin* in 2024, we shine the spotlight on seven academics at the vanguard of our research efforts. The following pages contain overviews of the seven outstanding projects that received funding from the Research, Academic and Industry Sectors One-plus (RAISe+) Scheme, as well as interviews with the projects' principal investigators. Launched as one of the initiatives in the Hong Kong government's 2023-24 Budget, the scheme provides funding of up to HK$100 million to each approved project on a matching basis, in the hope that this will encourage local universities to transform and commercialise their research and development outcomes. These seven projects — the highest number among local tertiary institutions — cover a wide range of topics: from silicon photonic communications to regenerative tissue engineering, from personalised medical AI systems to precision farming systems.



In addition to these researchers, we also look back at the Elsevier report. Published in May this year, it represented the first assessment of the research landscape in the Guangdong-Hong Kong-Macao Greater Bay Area (GBA) conducted by a major scientific publisher. The report has confirmed the University's continuing impact in the fields of medicine and technology, and its cornerstone role in the region's research output. As the region develops into a global innovation and technology hub under the central government's blueprint, this report shines a light on the ever-evolving impact of CUHK's research.

Diamonds are forever, but technology marches on. The 60th anniversary celebrations may have concluded in June this year, but as these pages will show, CUHK's commitment to excellence in its scientific research remains as steadfast as ever.

The RAISe+ projects

Launched in October 2023, the government's Research, Academic and Industry Sectors One-plus (RAISe+) Scheme encourages academics in local universities to translate their decades of research into tangible outputs that benefit society. Providing up to HK$100 million to each approved project, the scheme aims to help local universities commercialise their research and development (R&D) outcomes, and facilitate collaboration between the government and research sectors. In the following pages, we examine the projects that have gained this prestigious funding, and talk to their principal investigators about their journey in bringing their vision from drawing board to reality.

A key component of CUHK's research is robotics, as exemplified by Professor Liu Yunhui's continual quest to create vision-driven robots that can achieve real-time eye-brain-motor coordination. Similarly working with robots is Professor Samuel Au, whose project aims to develop a safe, affordable and cost-effective robotic platform that can be used for surgeries. Indeed, many of the RAISe+ projects centre on medical applications: Professor Barbara Chan's research is dedicated to the development of clinically usable living tissues that can mimic and replace defective ones; while Professor Zhao Ni has come up with a sensor-based AI system that can provide users with personalised health advice.

Some of the academics featured in this issue have developed products and technologies that help society face the future with confidence. Professor Tsang Hon-ki, an expert in silicon photonics, has set his sights on developing more robust photonic chips, significantly hastening signal connections in computers; meanwhile, Professor Raymond Yeung hopes to promote his network coding technologies to a wider level, enabling communication networks to become safer and faster. Nor are the academics in these pages limited to the realm of telecommunications: Professor Lam Hon-ming has utilised his expertise in soya bean research to develop sustainable food products that support healthy ageing. These seven professors may have different academic interests, but they all point to the diversity of CUHK's research, and their success is an undeniable milestone for the University.

CUHK Pro-Vice-Chancellor (Research) Professor Sham Mai-har (in yellow) and Secretary for Innovation, Technology and Industry Professor Sun Dong (green tie) were guests at the signing ceremony in May

Surgical robots and AI technology

Building a network of surgical robots

Professor Samuel Au

Professor Au's demonstration on the surgical robot

Mechanical and Automation Engineering Professor Samuel Au Kwok-wai has been passionate about robotics since childhood, and is particularly fascinated by moveable structures. In 2019, he established Cornerstone Robotics, a local unicorn startup that works to realise his dream of benefiting patients with surgical robots. To maximise his research's impact, he submitted a project proposal to the steering committee of the RAISe+ Scheme this year. The project, an Accessible Surgical Robotic System, aims to incubate a safe, affordable, effective surgical robotic platform for better patient care in Hong Kong, the mainland and the rest of the world.

Professor Au is a founding team member of the da Vinci Single-Site surgical platform and the da Vinci ION platform, and has spent almost two decades in the medical robotics industry. Talking about his participation in the RAISe+ Scheme, he says: "Funding from the government provides great support for our project, helping us bring high-quality robotic surgical platforms from Hong Kong to the world."

Professor Au also leads a team of top-notch experts at Cornerstone Robotics, who invented the Sentire Endoscopic Surgical System, the most complicated such platform developed in Hong Kong. This multi-port laparoscopic surgical robot is able to perform a 540-degree spatial rotation, which allows surgeons to overcome physical limitations. Surgical procedures can be performed in a safer, more efficient, standardised manner. "The endoscope

acts as the eyes of surgeons," he explains. "The surgical system enables operations to be performed with precision and dexterity. Its tremor filtration and motion control capabilities allow surgeons to perform complex procedures in confined spaces."

Professor Au believes that it is important for scientists to stay abreast of the technological landscape, and the RAISe+ Scheme provides an effective platform to commercialise research outcomes and enhance the capabilities of surgical robots. One of the team's plans is to overcome geographical barriers in healthcare procedures.

He explains: "We hope to build a comprehensive network that connects different surgical robots, so that surgery can be performed without geographical constraints. For instance, a surgeon in Shatin can perform surgery on a patient who is on Lantau Island."

Professor Au is confident that robot-assisted surgery can help with patients' wound healing and overall recovery. It also shortens operation durations and avoids unnecessary damage to the patient's body. "This project is a good collaboration example between our startup and InnoHK's Multi-scale Medical Robotics Center (MRC). Medical and engineering experts work together toward a common goal: to develop a safe and effective robotic platform to make robotic surgery accessible and cost-effective for more patients worldwide," he says. To date, the surgical robot has successfully been used on more than 180 human cases in various specialties such as urology, gynaecology, and general and thoracic surgery.

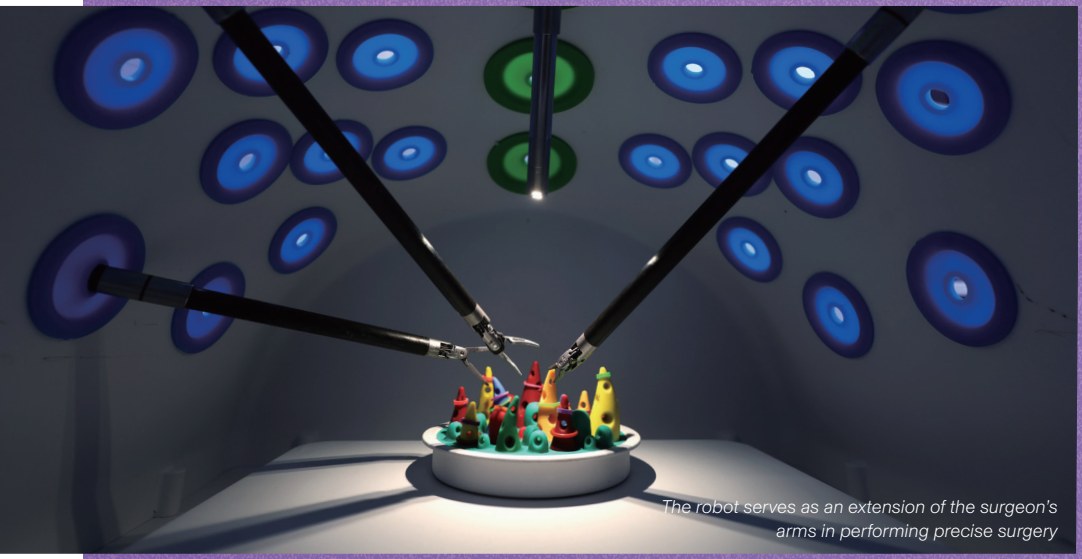
A perfect fusion of precise technology and artificial intelligence

"While medical and engineering technology are advancing rapidly, we should avoid being complacent," says Professor Au. With the rise of AI, the team is eager to combine the technology with surgical robots, which will assist surgeons in making the most appropriate judgements in the precise, complex surgery. "The robot's precision and surgeon's critical thinking work together to produce the best outcome."

"To me, robots are surgeons' inseparable work partners, which act like the co-pilot on a plane. We hope to gradually incorporate AI technology into robotic systems so they can cooperate with surgeons seamlessly."

"It is not easy to turn doctors' ideas into reality," says Professor Au. The team puts safety as their utmost priority and is committed to ensuring that the surgical system is reliable and stable in every surgery.

The professor recalls how complex the invention process was, requiring advanced technology to be



The robot serves as an extension of the surgeon's arms in performing precise surgery

employed while maintaining safety and stability. He believes that establishing a startup which gathers a team of 400 experts is necessary to address such a complex system integration problem. “Our Sentire surgical system has over 13,000 components; that’s more complicated than an electric vehicle (EV), in terms of actuation and control, as an EV has about 10,000 parts for actuation and control. The Sentire system adopted the full vertical system integration approach where we custom-design most of our actuators, gearboxes, motor controllers, sensors, PCBs, imaging system, and operating system.”

Sentire has passed all clinical trials and is ready for operation. “We are a local startup and hope that Hong Kong patients can benefit from the most advanced technology that is safe and affordable,” says Professor Au. The team is also eager to create a greater influence by bringing this ground-breaking technological invention to the world.

Shaping the future

Professor Au and his team have recently received the National Medical Products Administration (NMPA) registration approval for the usage of Sentire for operations in the mainland and Hong Kong. This is the first time that a Hong Kong-developed medical robot has received such an approval. They have also applied for European certification for Sentire, aiming to open the door to the future of healthcare. He hopes that surgical robots can tackle the shortfall in surgeons and help to standardise surgical procedures.

“There are approximately 20,000 hospitals on the mainland, and the number of times surgery is performed annually reaches 40 million, equivalent to the total of the United States and Europe combined,” he says, making it particularly important to standardise surgical procedures, so that more surgeons can be trained and more patients served.

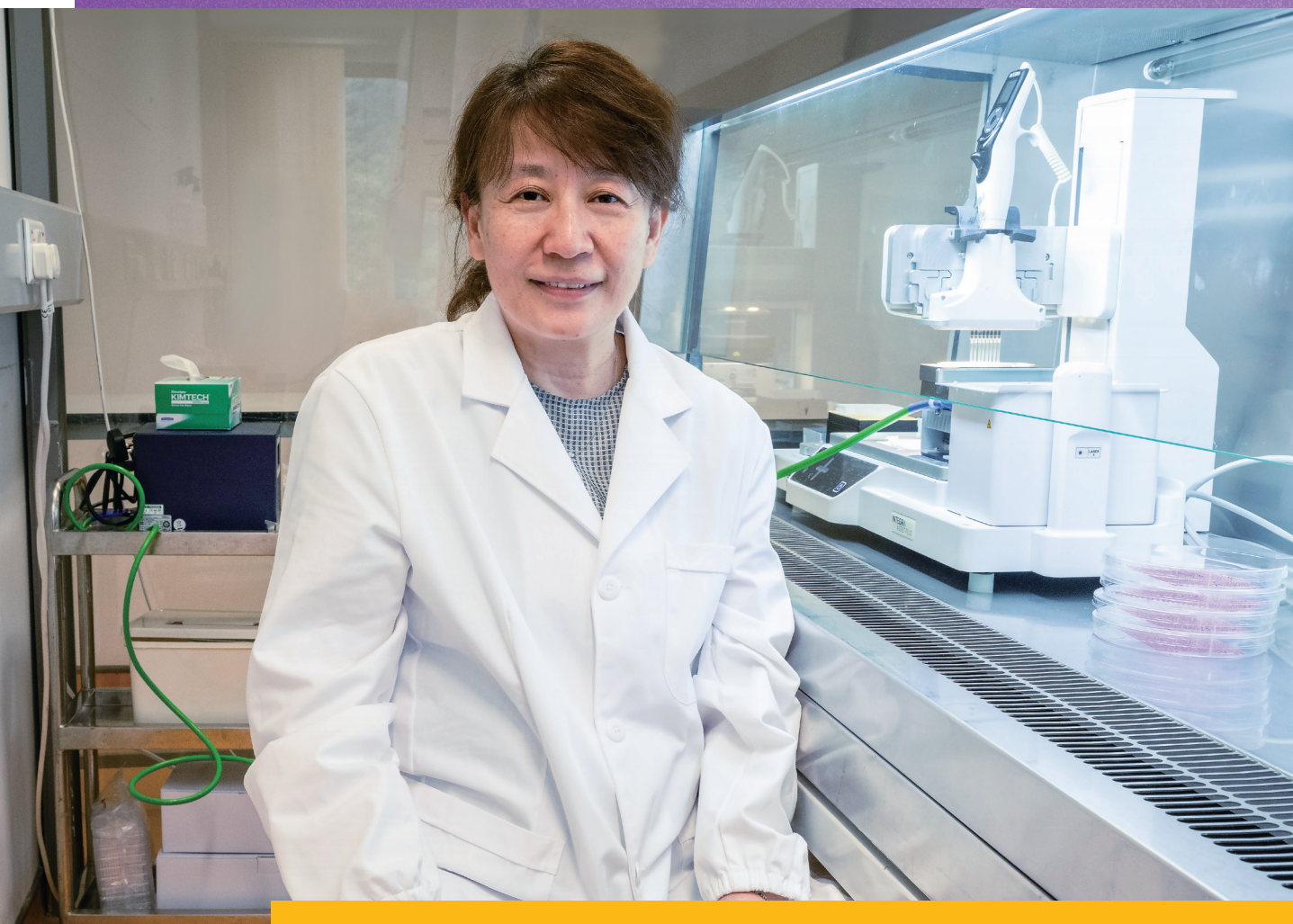
The engineer has one great ambition. “My dream is for every hospital to have a surgical robot platform developed by us,” he says. “I am proud to bring Hong Kong’s finest products and technologies to the world.”

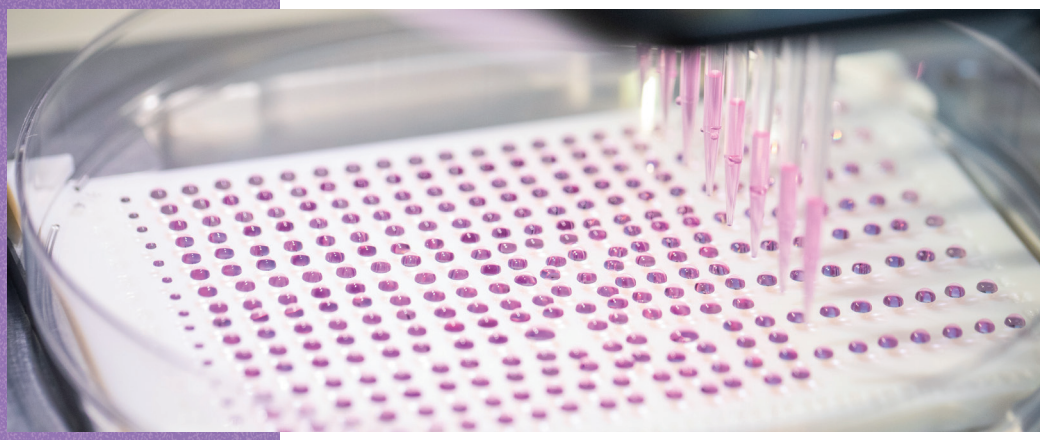
The Sentire Endoscopic Surgical System

Tissue engineering for precision medicine

On passion and perseverance

Professor Barbara Chan





The production process of eOCT

As one of the global pioneers in cartilage tissue engineering, Professor Barbara Chan of CUHK's School of Biomedical Sciences has been diving deep into tissue engineering and regenerative medicine research for over 25 years. She wants to benefit patients who suffer from tissue dysfunctions by developing safe, effective, personalised tissue engineering and regenerative medicine solutions.

Professor Chan's team strives to bioengineer clinically usable living tissues to replace defective ones. By integrating different technologies, they have developed bioengineered complex tissues such as engineered osteochondral tissue (eOCT) for cartilage regeneration. Her project "Development of Personalised Advanced Therapeutic Products (ATPs)—eOCT for cartilage regeneration therapy" has been funded by the inaugural RAISe+ Scheme.

In close collaboration with the orthopaedic team led by Professor Patrick Yung of CU Medicine, Professor Chan is realising her roadmap of eOCT development: from proof of concept to pre-clinical evaluation, from cadaveric studies on surgical implantation to process validation for Good Manufacturing Practice (GMP), and now conducting first-in-human clinical trials in Prince of Wales Hospital and Queen Elizabeth Hospital.

"This is the best era for doing interdisciplinary translational research. Compared with other countries and regions, local scientists have more substantial funding and infrastructural support from the Hong Kong government," she says.

Rekindling patients' hope for cartilage repair

According to *The Lancet*, about 595 million people worldwide were living with osteoarthritis in 2020, up 132.2% since 1990. The knee joint is the most common site for degenerative joint diseases such as osteoarthritis, a condition that causes pain, swelling and stiffness. Without blood vessels, cartilage cannot heal on its own once injured. In the worst-case scenario, the patient's knee joint needs to be replaced by an artificial one.

Professor Yung, who is responsible for the handling of joint replacement cases in the Hospital Authority's New Territories East cluster, says his team handles 1,000 cases per year but there are 4,000 to 5,000 cases on the waiting list. "And the list is getting longer as our society is ageing rapidly," he says. "Knee joint replacement is the most common orthopaedic surgery in Hong Kong. It takes around four to six years for patients to receive knee joint replacement surgery."

Surgical procedures, such as microfracture and autografting, can be used to treat traumatic cartilage damage but there are significant drawbacks. Microfracture involves drilling tiny holes into the bones underlying the damaged cartilage, but cartilage repaired in this manner is of poor quality and will degenerate quickly. Autografting involves harvesting a graft from a part of the joint to replace the damaged cartilage and is the clinical gold standard. However, owing to the severe side effects, such as chronic pain and degeneration due to injury of the autograft donor site, this procedure is no longer offered by surgeons.

Professor Yung has been applying matrix-induced autologous chondrocyte implantation (MACI) for two decades, a procedure in which a patient's own cells are used to regrow new cartilage for the knee joint. The patient's harvested cells are placed onto a film trimmed by the surgeon for implantation into the damaged area to regrow new cartilage. "It usually takes more than 18 months to fill part of the defect area, but Professor Chan's eOCT plug can completely fill the area immediately."

These regenerative complex tissue plugs allow orthopaedic surgeons to use the minimally invasive arthroscopy procedure to repair cartilage damage without the need to hurt the patient's own cartilage, like the existing surgical procedures do. "We grow the cartilage tissues *in vitro* using the patients' own stem cells and use the engineered cartilage to replace the damaged tissues. We are now translating this technology for use on humans," adds Professor Chan. The performance of eOCT has been proven comparable with autograft transplantation in animal studies.

Her camaraderie with Professor Yung furthers the synergy of their eOCT research

The breeding ground of innovation

Professor Chan is currently a professor at CUHK's School of Biomedical Sciences, Institute of Tissue Engineering and Department of Biomedical Engineering. She obtained her bachelor's degree in Biochemistry and her PhD in Surgical Science from CUHK. She was subsequently offered a postdoctoral fellowship in laser medicine at the Massachusetts General Hospital in the US. Before joining CUHK, she worked in the Biomedical Engineering programme of The University of Hong Kong. She is the first tissue engineering scientist to develop this technology to such an advanced stage.

The atmosphere of innovation, the multidisciplinary research culture and the research facilities at CUHK are the reasons for her homecoming. "The University values tissue engineering and regenerative medicine research, and multidisciplinary collaborations. The critical mass here, together with the visionary establishment of an ATP GMP manufacturing facility, is significant to tissue engineering research. I have collaborated with Patrick for many years. And I'm glad that we can translate eOCT technology into phase one of the clinical trial evaluating the safety of the technology."

The eOCT treatment takes about four months to complete, which encompasses patient medical screening, bone marrow harvesting, sample transportation to Singapore's GMP manufacturing facility, manufacturing eOCT in clean rooms, quality assurance tests by third party labs, minimally invasive arthroscopy and eOCT implantation by surgeons, followed by subsequent post-operation follow-up, data collection and analysis, for up to two years.

Locating a GMP facility that complied with Hong Kong regulations was challenging. She checked out cities like Beijing, Tianjin, Shanghai, Hangzhou, Xian and Guangzhou in her search for a feasible facility, but it turned out to be futile. "Due to regional differences in regulation of ATPs, the harvested samples processed in the mainland couldn't be used for our clinical trials. We ended up opting for a facility in Singapore, despite its longer turnaround time and higher cost," Professor Chan elaborates.

With funding support from the RAISe+ Scheme, she will set up the GMP manufacturing capability of eOCT in Hong Kong by working with the ATP GMP Centre of the Hong Kong Institute of Biotechnology (HKIB), so as to support subsequent clinical trials and commercialisation. The centre at the HKIB will provide a Pharmaceutical Inspection Co-operation Scheme GMP-compliant facility that produces clinical grade ATPs, including eOCT, for approved clinical trials and treatment.

The brave new world of personalised medicine

Professor Chan has established the Tissue Engineering Laboratory to improve patients' quality of life by bioengineering biomaterials and stem cell-based tissues for personalised therapies. Her research interests include complex tissue engineering, natural biomaterials, organoids and tumouroids, mechano-regulation, cell-material interface, multiphoton microfabrication and micropatterning, as well as laser medicine.

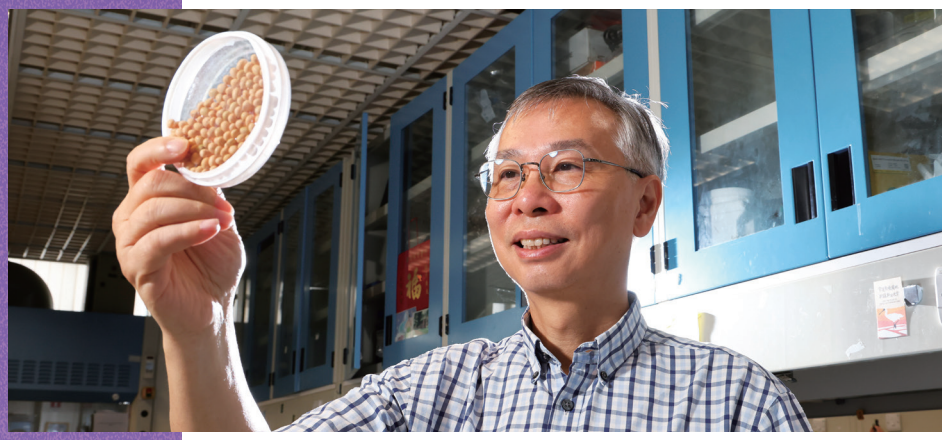
Her dream is to realise personalised cartilage regeneration within the healthcare system. "Some day in the future, patients with cartilage injuries may send their pre-stored stem cells from cell banks to professional tissue growth service providers for their made-to-order personalised eOCT as their tissue engineering option for arthroscopy implantation. Hopefully, the eOCT ATPs will allow them to regain motility and enjoy their preferred lifestyles soon afterwards."

To develop better therapeutics for patients suffering from joint problems, the team has overcome numerous technical and non-technical constraints, together with applying soft skills to cope with unexpected circumstances, in order to push scientific frontiers and bridge unmet medical needs. "Some challenges could be heart attack-triggering," she quips. "A manufacturing facility once indicated that they wouldn't continue their work due to sudden local policy changes, which would result in them discarding patients' samples." Her team tried to preserve them at all costs. She says, smiling, "Our commitment to serving patients fuels our courage to grasp the nettle."

Soybean genomic research

Seeding the future

Professor Lam Hon-ming



CUHK Choh-Ming Li Professor of Life Sciences Lam Hon-ming is dedicated to promoting climate-smart and sustainable agriculture, aiming to transform the future of our global community and village development with the power of scientific research. A pioneer in soybean genomic research, Professor Lam's project "Seeding the Future: Integrating Biotechnology, Space Technology and AIoT to Soybean Cultivation for Food Security and Environmental Solutions" was among the first batch of research projects accepted into the RAISe+ Scheme this year.

"RAISe+ is an effective platform which provides us with a valuable opportunity to transcend our research achievements beyond academia," he says. To this end, the team founded FARMily Biotechnology Company Limited to bring years of soybean research to fruition.

Speaking of commercialisation, Professor Lam is keen to transform research output into practical applications that can change the world, such as cultivating stress-tolerant seeds and providing climate-smart solutions to sustainable agriculture. The team will also focus on enhancing the value of agricultural products, including developing soybean functional foods to improve nutritional health in the elderly.

"Soybeans are rich in protein and isoflavones, nutrients that benefit people as they age. We believe that the development of soybean functional foods

is an area worth exploring," says Professor Lam. "Soybeans are not only rich in nutrients, but also carry high environmental and societal values."

The professor is also passionate about playing his role in shouldering social responsibility. He hopes to bring their expertise to the world by contributing a "Hong Kong solution" to global food security and sustainable agriculture. The team is striving to position the city as a leading hub for development in technology, certification, and quality assurance in the field.

"A dedicated portion of the profits arisen from commercialisation could be used to support further R&D endeavours and boost the income of farmers," says Professor Lam. "It encourages emission-reduced agriculture and makes it a win-win situation for both farmers and the climate."

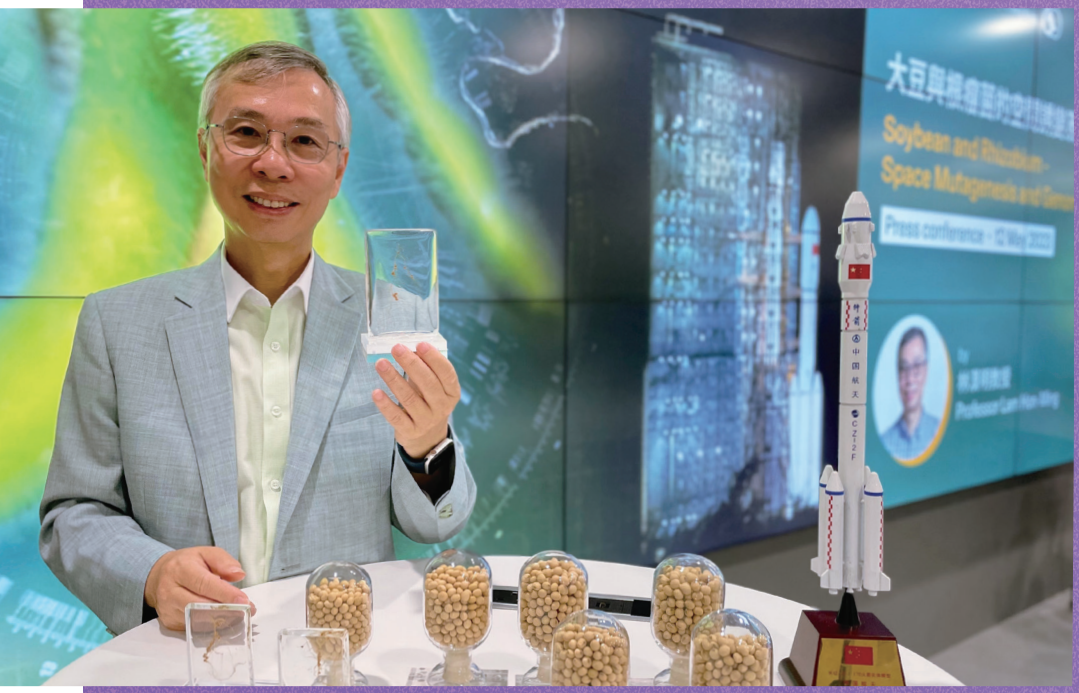
From lab to field: A path to food security and sustainable agriculture

Driven by the pressing global issues of hunger and food security, Professor Lam has been engaging in soybean research for more than a quarter-century. He notes that soybeans are highly nutritious as they account for 70% of the world's plant proteins.

Increased soybean yields and the production of functional foods can provide sufficient protein to impoverished areas that cannot afford meat, so as to end hunger and improve global food security. At a poverty alleviation programme in 2009, Professor Lam met Professor Zhang Guohong from the Gansu Academy of Agricultural Sciences, who has extensive experience in dryland agriculture research.

In 2014, Professor Lam and his team successfully identified and cloned a novel salt-tolerance gene from wild soybeans by using advanced genomic sequencing and molecular biotechnology, which has significantly enhanced the development of salt-tolerant soybeans. Subsequently, using non-GMO (genetically modified organism) methods, the two professors were able to make use of the novel gene to select and cultivate soybean varieties (Longhuang 1, 2, and 3) with high yield, stress tolerance and wide adaptability. The cultivation of the Longhuang series in Gansu province has alleviated local planting issues and improved the livelihood of farmers.

Out of the 120 million hectares of farmland in China, more than 33 million hectares are affected by salinisation. This is particularly severe in northwestern areas like Gansu. Hence, Professor Lam and his team donated these three climate-



resilient soybean varieties to farmers to grow on marginal lands of the Loess Plateau in Gansu province. Cumulative acreage of Longhuang 1, 2 and 3 reached more than 78,666 hectares from 2016 to 2023, actualising the professors' common vision to "display science on field". Professor Lam explains: "By 2023, the cultivation of the Longhuang series had added RMB 97 million to farmers' incomes. Greenhouse gas emissions were reduced by the equivalent of 82,600 tonnes of carbon dioxide." Thanks to the symbiotic relationship between legumes and nitrogen-fixing bacteria in root nodules, atmospheric nitrogen is converted into organic forms usable by crops, allowing farmers to reduce the use of fertilisers, which reduces greenhouse gas emissions and promotes global sustainable development.

To boost the impact of his research, the professor has stepped out of his comfort zone by taking nitrogen-fixation rhizobia and soybean seeds on a space journey. Last year, the team collaborated with China Resources Research Institute of Science & Technology and Shenzhou Space Biotechnology Group to initiate Hong Kong's first agricultural research project in space. The "Tianzhou-6" cargo spacecraft and "Shenzhou-16" carried nitrogen-fixation rhizobia and Longhuang 1, 2, and 3 seeds to the "Tiangong" space station, exploring new opportunities induced by the unique environment of space. Currently, the experimental samples have completed a six-month space journey and have been sent back to Earth for further analysis.

In the world of scientific research, Professor Lam believes that what seems like a small step today may become a giant leap in the future. "I hope to lead Hong Kong's soybean research to the world, paving the way for a sustainable future for the next generation."

Professor Lam and Professor Zhang (left) inspect the growth of the Longhuang series in Gansu

3D vision-driven robots

Making robots ever smarter

Professor Liu Yunhui

3D Vision-Driven Picking Station in a real warehouse

Professor Liu Yunhui has been devoted to building robots his whole career. His innovations in industrial robots have marked milestones in robotics at CUHK, most notably the vision-based autonomous forklift his team developed in 2016, which has been deployed by warehouses around the world and helped his startup grow into a unicorn.

In recent years, Professor Liu's team has focused on developing innovative products and applications for 3D vision-driven robots in various domains, including smart factories, smart warehouses and smart cities, aiming to make them smart enough to operate not just in industrial contexts, but also in the service industry, where environments are more dynamic, sometimes with humans around. These 3D vision-driven robots should have good eye-brain-motion coordination like humans, responsive to changes, he says.

"An ordinary robot does not have eyes. You need to teach it how to walk, how to pick up an object and then come back – it keeps repeating these steps. It does not have human intelligence," Professor Liu explains. "In some industrial settings and in service industries, there are people around and the environment is full of uncertainties. The tasks required are not so repetitive. This gives rise to safety problems."

Perfecting eye-brain-motion coordination

Now, with funding from the RAISe+ Scheme, Professor Liu's team aims to develop and commercialise technologies and products involving 3D vision-driven robots that realise effective real-time eye-brain-motion coordination for more versatile, safer operations. The robots will be useful in modular construction for measuring modular parts, and in the automotive industry for automated measurement of parts and batteries, as well as for car inspection. The robots could also be deployed in robotic grasping in warehouses or other settings.

The team comprises multidisciplinary experts from CUHK's Department of Mechanical and Automation Engineering, of which Professor Liu is a member, and the Department of Computer Science and Engineering, including Professors Fu Chi-wing and Dou Qi. The funding will give them a boost in transferring the years of knowledge they have built up into real-world applications for Hong Kong and beyond, Professor Liu says.

Existing 3D vision robots have slow visual feedback, making it challenging to perform operations safely, quickly and with high adaptability, he explains. For industrial or service robots to accomplish complex tasks, they need to achieve eye-brain-motion coordination similar to humans. Current products have a frequency of only 0.5-2Hz. The team's goal is to develop 3D vision-driven robots with coordination frequencies closer to humans', reaching 200-1kHz.

"Primarily, we want to improve the artificial intelligence here. This way, robots can perform tasks like sorting and shelf stocking in a logistics setting and retail stores," Professor Liu notes. "For instance, while we already see robots serving meals in restaurants, most of them can only roll back and forth, and do no more, still lacking the versatility needed for more dynamic and complex operations. I hope they could adapt to more intricate tasks, like helping to clean up tables or taking up simple tasks in the kitchen in the future, with high versatility."

AI that understands the physical world

Professor Dou, who has been developing computer algorithms and accumulating substantial experience in robot vision research, explains that traditional robotic vision is mainly semantic, which means a robot is capable of interpreting visual data in a way that assigns meaningful labels to identify objects and scenes – "an apple" or "a water bottle", for

Professor Liu and Professor Dou Qi (left) with the 3D Vision-Driven Picking Station

example. The team is aiming to give these abilities a major boost.

"In the current project, we are also getting the robot to estimate accurately the pose of the object in front of it and to calculate the relative positions of the object and the robotic arm in three-dimensional space, so that the robot can plan the motion of its arm to grasp any randomly placed target objects from suitable angles. This way, robotic arms will provide greater flexibility than before."

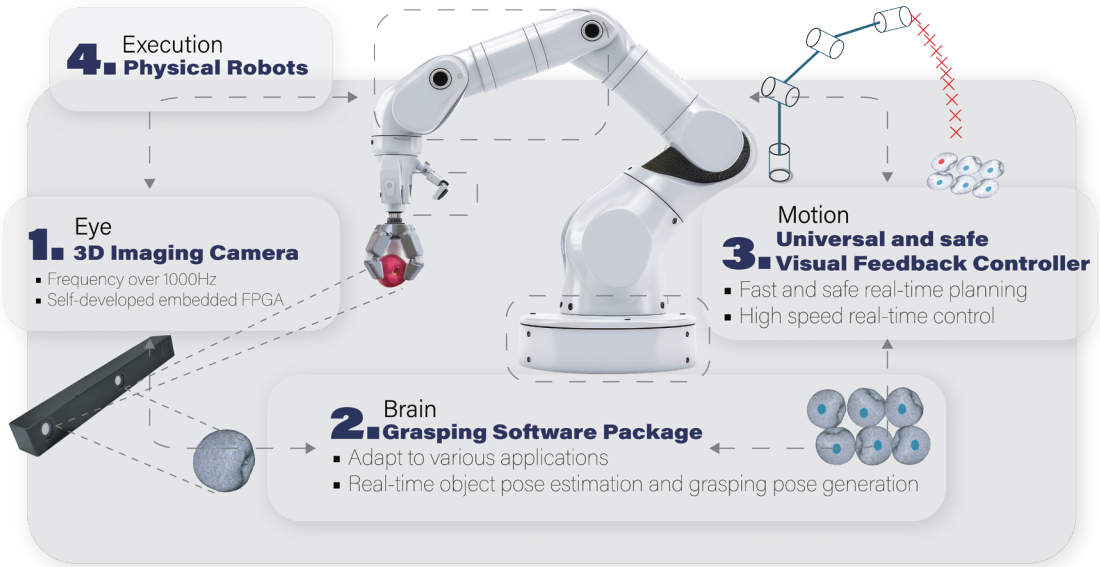
Artificial intelligence models currently on the market mostly focus on collecting and organising various corpora and feeding them into neural network inference models for the computer to learn, she notes. They primarily rely on language model-based machine learning techniques to effectively accomplish natural language processing.

"However, these AI systems are generally believed to have limited understanding of the physical world. For instance, when we need a robot to grasp an object, where should it place the object afterwards? We need to help the robot develop a thorough understanding of the real world, collecting data from warehouses and actual scenarios in the service industry in order to build and adapt large AI models."

In preparing for the RAISe+ application, Professor Liu says everything has built on the team's collective efforts over the years.

"You need to accumulate a lot of experience and knowledge over a long period of time and then identify suitable applications. It's equally important to develop what we call 'deep tech', where your technology is competitive and innovative," Professor Liu remarks. "Lastly, bring in industry partners."

The project team will closely collaborate with some of these partners to drive the commercialisation of three-dimensional, vision-driven robots in various fields. Companies like China Resources and Wuling Motors are on board to provide different service, industrial and construction scenarios for the team to explore.

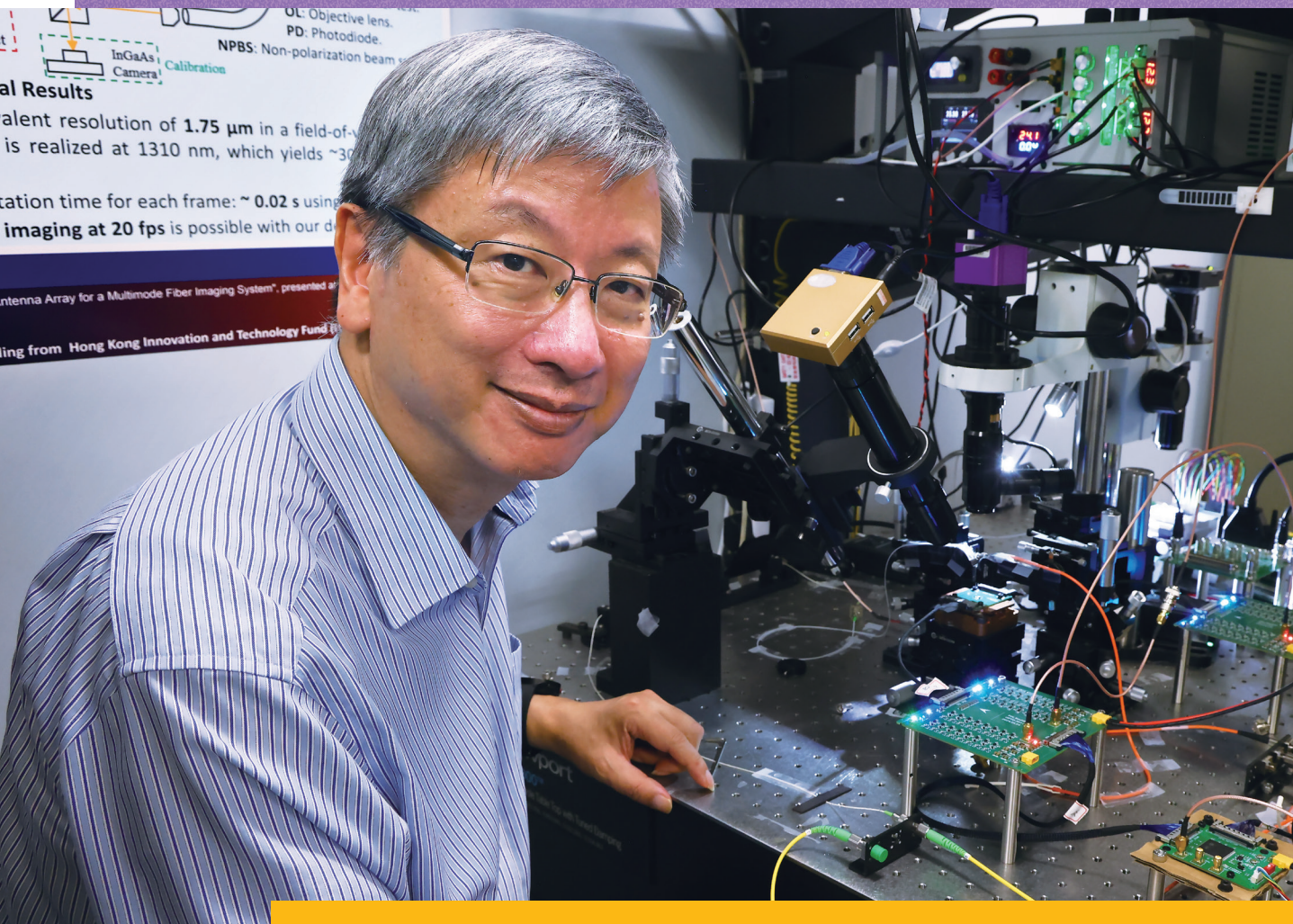


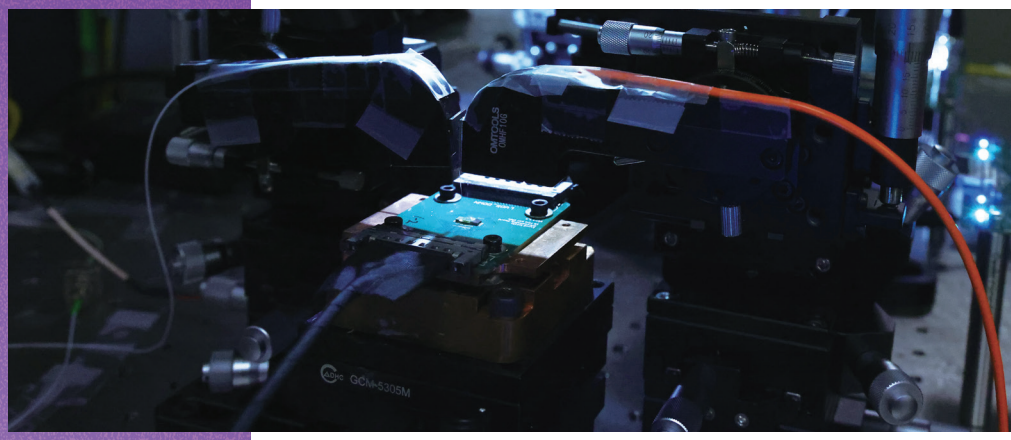
Components of the 3D Vison-Driven Robot being developed by Professor Liu's team

Silicon photonic chip design

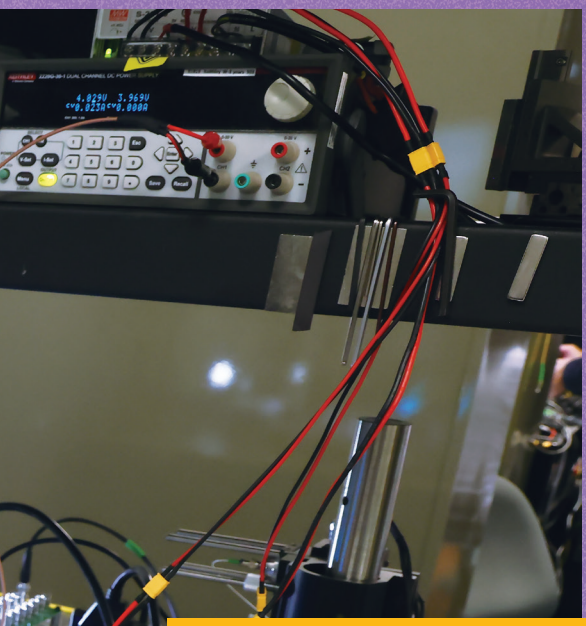
Communications at the speed of light

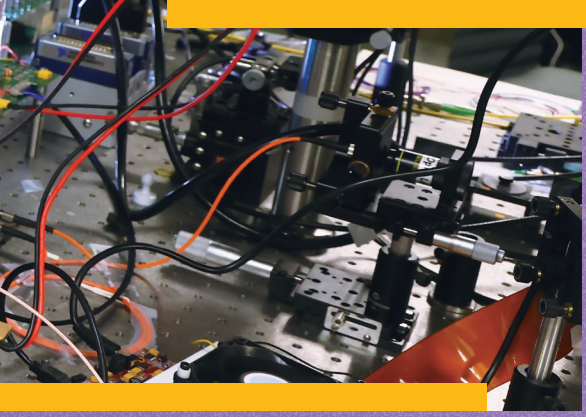
Professor Tsang Hon-ki





One of the components of Professor Tsang's research in silicon photonics





It was boredom that drove Professor Tsang Hon-ki into his current academic field. While an undergraduate student in engineering at the University of Cambridge in the 1980s, the current Dean of Engineering at CUHK spent a few months interning at a telecommunications company. There he quickly realised that his passion was not in writing computer code: "I was bored out of my mind," he says. "I was just facing the same code and then debugging the code and doing the same thing there, and I thought 'after I graduate, I do not want to enter that as a profession'." Having also worked at that company's optical fibre communications lab, he found himself more fascinated by the fledgling optics industry and its possibilities. This sparked a lifelong interest in optics that has culminated in his leadership of a startup dedicated to the design of silicon photonic chips.

Most silicon chips these days contain many electrical signals which enable information to be transmitted. However, as such signals also generate heat on the side, this creates problems: "If you go beyond around five or six gigahertz, which is the switching speed of a notebook computer, the electric wires will generate so much heat that the chip would become unusable," says Professor Tsang. On the other hand, light presents no such issues, as optical signals can be switched very quickly: "100 Giga-baud [a speed unit] is no problem, and you can transmit that for kilometres because that's the advantage of using light. So you can go at whatever

speed you like and you can go long distances without loss."

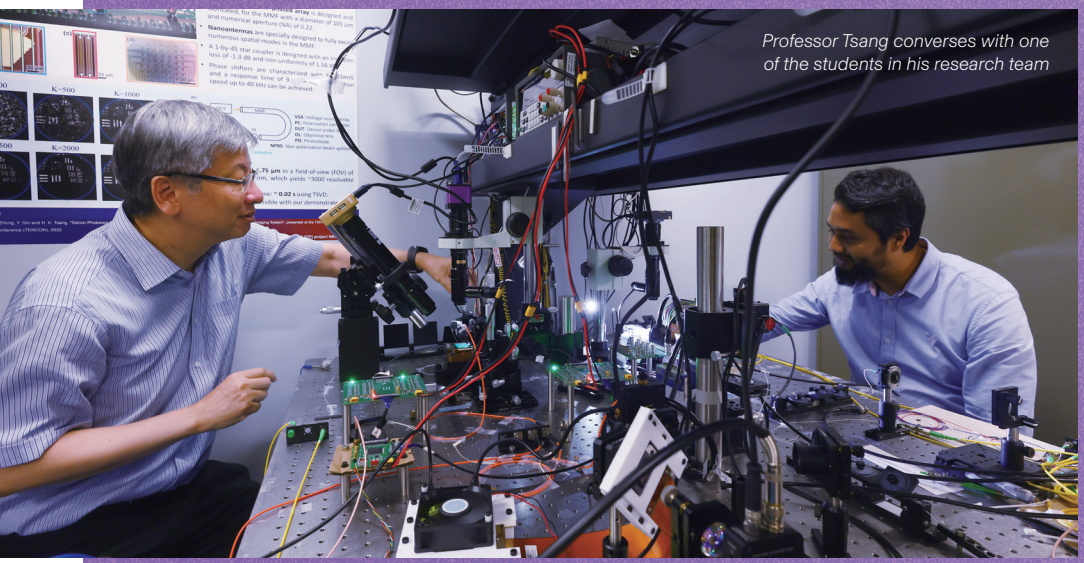
This area of academic study, known as silicon photonics, has become increasingly relevant with the ever-increasing amounts of information being transmitted every day. Back when the professor first focused on the subject in the late 1990s, "you could literally, with one batch of wafers, supply the whole of the world with the wavelength division routers that telecom systems needed, and it was commercially unviable for a company to run a semiconductor fabrication facility just for silicon photonics products for the limited telecom market."

But since then, he explains, optical interconnects for computers have become mainstream technology, and now there exist many new silicon photonics fabrication foundries. It is therefore now possible for a company to become established without having a fabrication facility of its own, following the well-established fabless design house business model in the microelectronics industry. In the last 20 years, the professor has steadily built on his research, contributing to the latest technologies in the field. Today, just as the digital world grows ever more information-hungry, his research on silicon photonics has proven to be a serendipitous career choice.

Many hands make light work

Professor Tsang's expertise is not merely limited to the world of academia: he was previously director of R&D at Bookham Technology plc, a UK-based startup which at its peak valuation had a market capitalisation that ranked it among the top FTSE-100 companies. This brief detour into the world of business seeded the vision for the startup with his CUHK research team this year, one which focused on perfecting the design of silicon photonic chips. "What we are trying to do here is to form a startup company which is focused on our core strength of silicon photonics design, and to work with existing companies, introducing them to some of our latest technology that may help them to reduce product costs and improve the performance of the products by having a chip that is robust to mechanical vibration." This emphasis on product design, he notes, is similar to "fabless" microelectronic companies like Qualcomm and Nvidia.

His efforts caught the eye of committee members of the RAISe+ Scheme. Professor Tsang's application was shortlisted for interview in early 2024, and his team was quickly selected for funding approval in principle in May this year. They named their firm "OptiHK", a play on the German word *optik* that also emphasises its local roots; although the company is now still in its infancy, the professor is optimistic about its prospects, raising the example of semiconductor giant Qualcomm: "today it's a $170-billion company, but they started with seven people in 1985. They had a lot of IP on the wireless mobile phone and wireless chipset, and we hope to be in a similar position with the technology for the silicon photonics industry."



Professor Tsang converses with one of the students in his research team

And the way the professor sees it, the opportunities are boundless. With silicon photonics, connections are no longer limited by their heat by-product, so not only are operations faster, but they also consume much less energy. “And it's not just in the communications industry,” he adds. “It could also improve the devices for healthcare: for example, in the optical coherence tomography (OCT) market, we use light to detect underneath the skin potential skin cancer, or other diseases through 3D imaging in real-time. Today, these are desktop-based systems that are not yet widely available; with this chip technology, we can reduce it to a tiny handheld platform. And we hope to make this so low-cost, that it becomes as cheap as a smart watch.”

The professor is confident that OptiHK’s products can succeed because of their solid foundational research, which he and his team have conducted over the years. “The know-how that we have developed in our group is amongst the best in the world in silicon photonics. In terms of device design, we are leading the field in that we have the lowest loss between the chip and optical fibre using the manufacturable boundary technologies.” Far from hindering their prospects in the business world, Professor Tsang believes that their base in CUHK and the academic world has actually provided them with a leg up over traditional industry. “As a university-based group, we need to stay at the forefront of the technology, whereas in industry there is a lot of pressure to make products that make use of older, more mature technologies.”

A bright future awaiting

Although he remains firmly rooted in academia, Professor Tsang is still keenly aware of the need for students to develop their own business acumen. For some years, he taught an undergraduate course on engineering entrepreneurship. Many local students, he says, have “very little experience in the real world — they may understand mathematics, they may understand circuit design, but they don't really see how this can be put together for making products to make money.”

Like former CUHK Vice-Chancellor and “father of optical fibres” Professor Charles K. Kao, Professor Tsang is devoted to the application of light in communications

As a result, he started a course that aimed to utilise his own exploits as an R&D director and help these students look beyond mere technical aspects. “Technology is an enabler, but if you want to make money, you need to make products that can sell, and to do that you need to offer your customer something that has value.” This is a philosophy that has also informed the professor’s work at OptiHK; although he currently acts as principal investigator for the company, he sees himself more as a mentor figure for an upcoming batch of budding students. “My motivation in doing this,” he says, “is to try to see how the fruits of the last 20 years of my research can benefit the wider society, as well as give meaning to the research of many of my students, to help them show that this technology can change the world.”

He hopes that his guidance will allow the firm to survive and thrive in the long term. “Today, we take for granted microelectronic chips; in the future, maybe 30 years from now, every chip in every computer you buy will have some photonic technology.”

Network coding for smart cities

Making Hong Kong a world-class smart city

Professor Raymond Yeung

Professor Raymond Yeung, Choh-Ming Li Professor of Information Engineering and Co-Director of Institute of Network Coding at CUHK, and co-founder of n-hop technologies

Common elements of modern lifestyles, like attending video conferences, streaming TV dramas and shopping online, require an information superhighway to transmit data. However, the high volume of traffic on the highway leads to frequent jams, resulting in data loss and sluggish images. Professor Raymond Yeung Wai-ho's network coding theory offers a solution.

His project "Network Coding for Next Generation Networks" was among the first batch of research projects accepted into the RAISe+ Scheme this year. The project will primarily concentrate on the deployment of BATched Sparse (BATS) code, which greatly increases the network transmission rate and reduces distortion caused by data loss.

Professor Yeung's project targets three critical domains: cellular networks, smart cities and data centres. Besides undertaking the necessary R&D, his team aims to expedite the market introduction of their innovative products by collaborating with industrial partners. He hopes that BATS code will help realise Hong Kong's smart city vision and its 5G infrastructure-based development, and make it a world-class smart city.

Visionary perseverance in enhancing data quality

Data transmission in networks is akin to routing data packets through nodes that act like postal relay

stations. “When two ‘parcels’ are sent to the same intersection, they are stored and categorised before being forwarded to the next node,” as Professor Yeung describes it. In the context of wireless networks, the more nodes that the parcels pass through, the more serious the data loss becomes.

“Increasing the transmission power of wireless signals to extend the transmission range could reduce the number of relay nodes. But it will interfere with the signals of other types of wireless communication,” he adds. Network researchers have been looking for solutions to reduce data loss without affecting transmission power.

He left AT&T Bell Laboratories, a premier US research laboratory, in 1991 to join CUHK’s Department of Information Engineering, where he delved into network research. Researchers previously believed the best way to send a message through the network was to encode it into data packets for high-speed delivery, without altering the packets inside the network. But he proved that mixing data packets inside the network could transmit more information. He coined the term “network coding” to describe it.

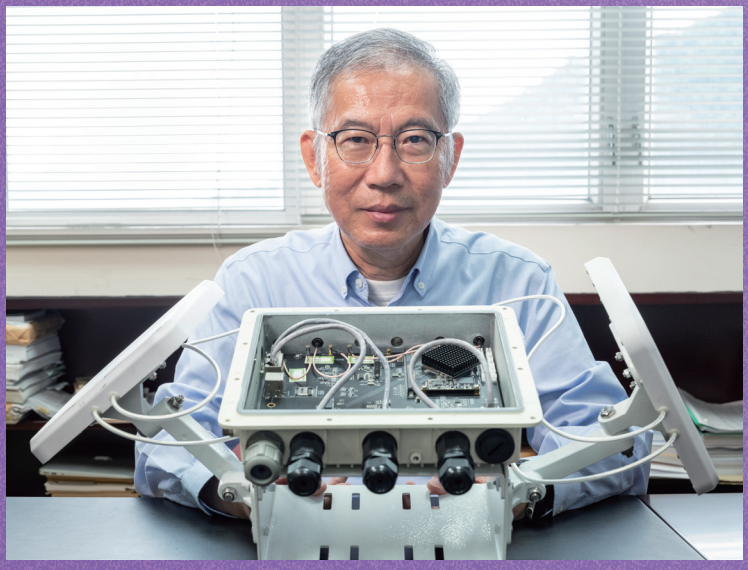
“I spent seven to eight years working with collaborators at CUHK and overseas to develop the theory.” His foresight and perseverance gave birth to a paradigm shift, enabling more information to be transmitted through networks at a faster rate, so that, for example, data can be downloaded faster from the internet and video streamed with less delay.

The butterfly effect that trumps traditional routing

With the aim of maximising the theoretical throughput of network communication, Professor Yeung and his colleague Professor Robert Li Shuo-yen came up with a novel example called the “butterfly network”, in which they showed that with network coding, information can be transmitted faster than with the traditional “store-and-forward” paradigm.

“The data are sent as coded packets in the butterfly network. The data packets received at the intermediate network nodes are encoded into new packets that are sent to the next node, where the original message is reconstructed at the destination nodes,” he says.

The technology later evolved into BATS code, which is a joint effort between Professor Yeung and his former PhD student Yang Shenghao, now a professor at the School of Science and Engineering at CUHK-Shenzhen. BATS code simplifies the encoding and decoding processes to increase network throughput, reduce delay and make the network more robust. Their project, “Network Coding for Next Generation Networks”, was recognised by the government's RAISe+ Scheme this year.



Maximising possibilities with R&D commercialisation

With his dream of scaling up communication networks and data storage systems towards enhanced efficiency, reliability and security in favour of smart city developments, Professor Yeung co-founded n-hop technologies with Professor Yang in 2018. The tech startup's name implies the pros of BATS: the transmitted information remains intact after passing through a vast number of wireless links. Three years after its inception, the startup received its first round of venture capital funding.

In summer 2019, n-hop technologies successfully deployed BATS in the Hong Kong government's pilot smart lamppost system. Laying new optical fibre is not only expensive, but also very disruptive to traffic and pedestrians. BATS provides a wireless internet connection for the smart lampposts without the need to lay optical fibre to everyone. The benefits include low operating cost, enhanced security and stable bandwidth, providing a city-friendly, economical solution that can enable massive deployment of the technology.

The startup also worked with the government on a pilot project at the Lantau Country Park to provide WiFi services using BATS in locations with weak cellular coverage. WiFi has an advantage over cellular because it can be used by all mobile phones, regardless of the network. He adds, "Besides providing hikers with a WiFi network, BATS can be used for weather signage, emergency buttons, wildfire detection, environmental data collection and so on."

Vision, focus and clarity

To date, there are three BATS-related technologies with 11 patents, which have a wide range of applications, such as a shared satellite broadcast communication network that propels the development of aerospace technology, and an underwater sonar transmission network for monitoring the operation of underwater infrastructure, so as to overcome barriers in ocean data transmission.

Network coding theory is a major breakthrough in information sciences. Its fundamental concept was introduced in the late 1990s, largely due to the visionary hypothesis of Professor Yeung. He has won numerous accolades for his contributions, including the Institute of Electrical and Electronics Engineers' (IEEE) Richard W. Hamming Medal, one of the highest awards in electrical engineering, and the Claude E. Shannon Award, the highest honour in the field of information theory. He was also elected a Fellow of the US National Academy of Inventors.

Professor Yeung's bold attempt at mathematical reconceptualisation has the potential to become one of the most far-reaching telecommunication applications. Network coding theory has been offered as a postgraduate course by universities around the globe. His team is now working with various standards organisations to make BATS code one of the international communication standards. However, going from theory to application may take decades, he says.

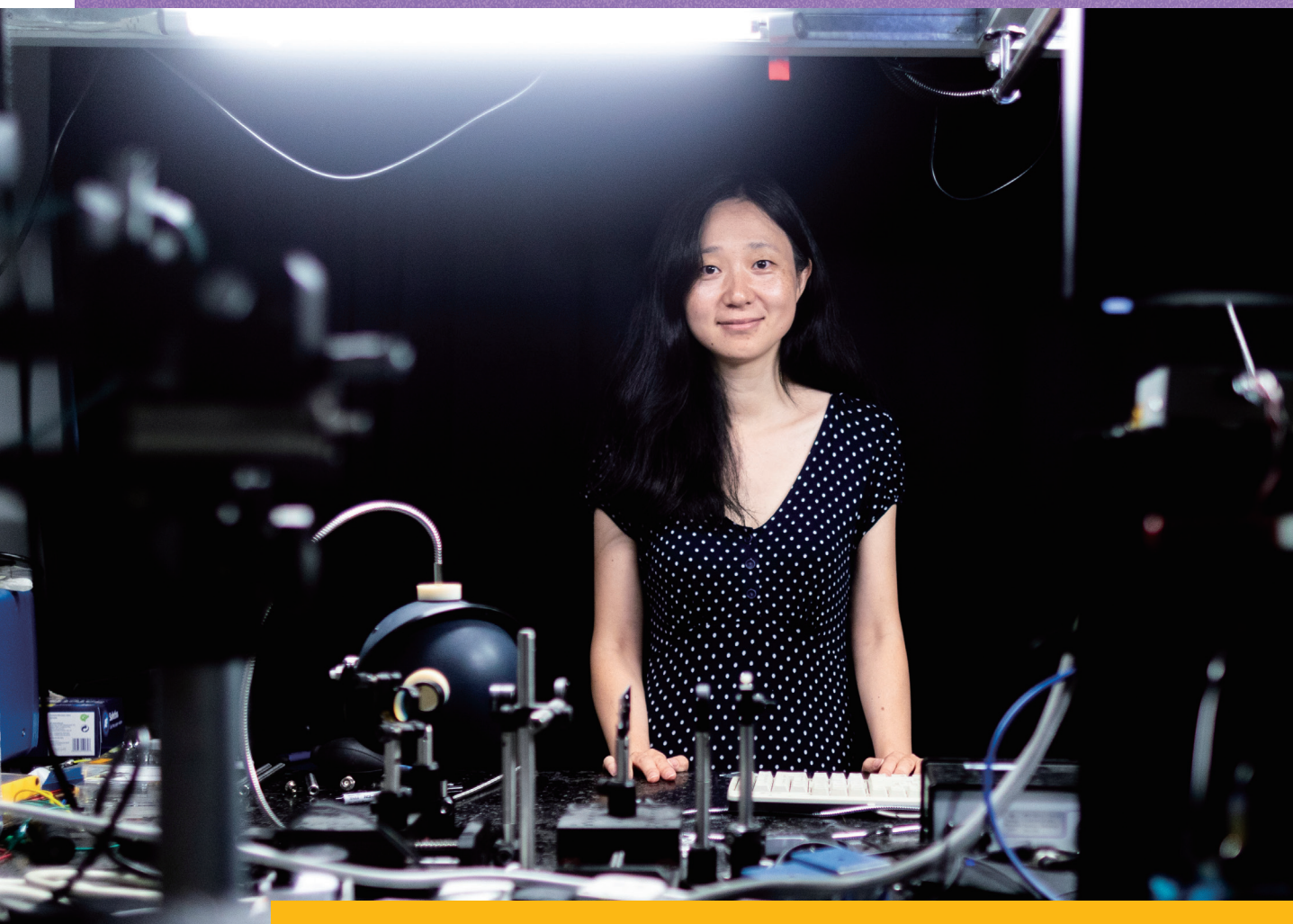
He also enjoys photography, playing the harmonica and practising tai chi. The common thread among these hobbies is concentration, which facilitates the mental clarity necessary for conducting rigorous research. "This attitude is much inspired by my PhD supervisor Professor Toby Berger, who is talented in explaining difficult concepts through writing," he says.

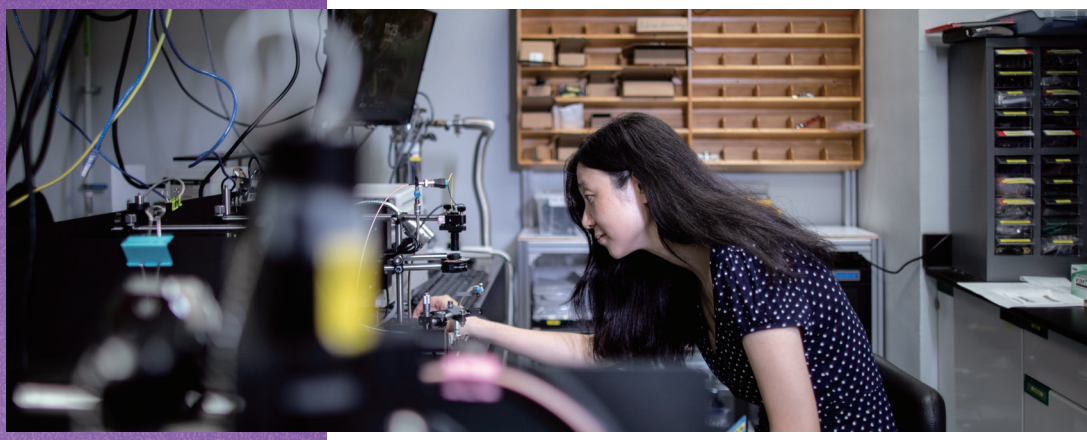
Smart lampposts support a wide range of smart city applications, including autonomous driving, intelligent transportation, real-time surveillance and high-speed WiFi coverage on a city-wide scale (photo courtesy of n-hop technologies)

Wearable sensors and personalised AI

A sensor-ble solution

Professor Zhao Ni





Ever the engineer, Professor Zhao looks into the mechanical components of her project

Of all the factors that matter in Zhao Ni's research, the one she returns to the most is utility. "We are in the discipline of Engineering," says the professor of Electronic Engineering, "and I think a shared value in this discipline is that we should develop useful technology."

This focus on utility most recently culminated in Professor Zhao's proposal being chosen by the RAISE+ Scheme. Her research hopes to improve the detection of cardiovascular diseases (CVD), and funding from the scheme will support her team's research on wearable medical devices that monitor vital signs, enabling personalised artificial intelligence (AI) to tell the user how their body is doing.

If this sounds like it can replace a trip to the clinic, the professor is quick to stress that the use of AI will not threaten the medical profession. "Our goal isn't to replace doctors, but to offer more immediate help to patients, particularly those with CVD, who want to know their situation better. We also aim to equip doctors with more comprehensive information, so that they can better track and understand the progression of the disease."

'The more you interact with your own model…'

"I have always had engineering in my blood, in my genes," says Professor Zhao. "I wanted to do physics more on the experimental side, you

know, not very theoretical." Her life in academia has long been characterised by this pursuit of utility: as a young student of materials sciences and engineering at Tsinghua University, she was fascinated by new scientific breakthroughs announced in the media from time to time. It was the ability to apply what she had learned that captivated her, all the way to a PhD specialisation in optoelectronics, the study of devices that utilise light, at Cambridge University. From there she took up a post-doctorate fellowship at the Massachusetts Institute of Technology (MIT), where she deepened her research.

CUHK became her next career move after she read an article about the University in the *South China Morning Post*. But it was a conversation with a colleague, Professor Zhang Yuan-Ting, that gave Professor Zhao the idea to look into sensors. "At the time, we were both examiners of the final-year projects, and one particular student didn't do a particularly impressive job. But after the student left, we started to talk." An expert in wearable devices and sensors, the elder professor asked for her opinion on potential improvements to that project. This casual conversation started off a very productive partnership where the two professors' expertise fed into one another. As a result, she started looking into the field of flexible electronics, and how they might be utilised for healthcare.

All this research culminated in a project that the two professors have since presented to the steering committee at the RAISe+ Scheme. This project, she explains, consists of two components. The first is a series of wearable medical devices, developed by Professor Zhao and her team, that track risk factors of cardiovascular diseases (CVD) in the body. "These wearable sensors can collect all the necessary vital signs, including heart rate, blood oxygen level, blood pressure; but also some other parameters that may be less familiar to the public, like arterial stiffness."

All these signs are then fed into the second component: a personalised AI system, which Professor Zhao's team has named "Dr. PAI". This system, she explains, "combines the beauty of generative AI models with the most advanced sensing technology". Generative AI models (the most famous of which is ChatGPT) draw on vast amounts of information to generate their own responses; Professor Zhao's new system similarly draws on the wide range of data collected from the various connected devices to create feedback to the user, advising them on different health issues, as well as steps they might want to take to minimise risks to their health. As time goes on, the system will also learn to recognise their habits and adjust accordingly: "The more you interact with your own model, the more the model learns about you; and the more data you fit in this model — and I mean physiological data — the more it knows whether this is a transient thing, or whether you have a problem".

Wearable sensors gather information about the user's health

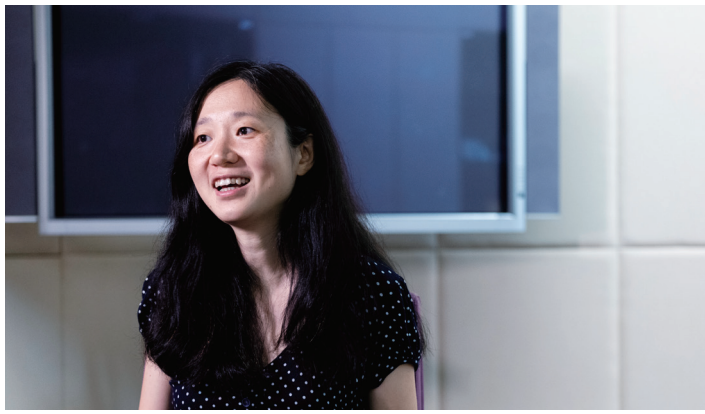
The human and the machine

This approach may sound novel, but the professor explains that it only follows established trends in medicine: “during the Obama administration, the US had already been promoting what they called ‘precision medicine’. So they see that healthcare has to be personalised, and the best way of collecting personal [health] data is to collect it during your daily life”. The “unique human-and-sensor-in-the-loop approach” of Dr. PAI will also allow it to interact with users, and tailor its health advice: although most people are aware of the importance of healthy living, the haziness of the term means that it can assume different forms to different people; the individualised approach of the AI system will allow users to tackle underlying risk factors according to their own needs.

Professor Zhao is eager to point out how Dr. PAI might compliment the healthcare system. Although citizens of Hong Kong can access medical attention with relative ease, this is not the case for many people around the world. “For areas that have very limited hospital resources,” she says, “it's very difficult to arrange an appointment with doctors, and in Hong Kong, this is also the case in public hospitals. So in between the appointment, you can have some sort of intermediate method to understand your situation, and adjust if necessary.”

Keeping the faith in the next generation

For Professor Zhao, developing projects like Dr. PAI for general use is a natural extension for academics. “When I was in MIT,” she says, “the coolest thing among students was not which professor had published a paper or whatever. It was whoever had started a company, received investment, and gotten a very cool product.” She feels passionately about the need to turn the fruits of one's research into something that can help the community and humanity at large: “For us, the existence of [research] fields like sensors is because of need: if we cannot deliver anything that can be useful in the end, this field would die! So to keep people having faith in this field, I think we have to have successful commercialisation.”



This is an ethos that she has maintained over a decade and a half of research. In her capacity as Vice-Chair (Graduate) for the Department, she oversees a vast cohort of postgraduate students, and supervises a large group of budding academics herself. “When I supervise students, I spend more time on the first-year students, because that's when I encourage them to look for new projects, new directions for their PhD,” she says. She clarifies that she does not cast aspersions on their hopes and dreams, but she is eager for her supervisees to “slowly understand the value of research”, and how it might be turned towards practical purposes. “Impossible is fine,” she says, “because if something's very useful, maybe you can do your impossible projects! But we should also analyse, from the scientific side, whether it's theoretically possible.”

Igniting impact

Landmark CUHK-Elsevier report shows CUHK is playing a lead role in GBA research powerhouse

The Guangdong-Hong Kong-Macao Greater Bay Area (GBA) has been one of the world's fastest growing research clusters since the region was designated by the country in 2019 to develop into a global innovation and technology hub. In this, CUHK is proudly a strong driving force.

CUHK research is making the highest scholarly impact overall, and especially in medicine and computer science, compared with other institutions in the GBA, according to a landmark report commissioned by CUHK.

The scholarly impact of CUHK's research output overall surpasses all other universities, government research organisations and corporate research institutes in the GBA, and the University boasts one of the most internationalised research portfolios, says the report independently produced by Elsevier, a leading information and data analytics firm.

Elsevier's report is the first assessment of the GBA research landscape conducted by a major scientific publisher since the central government outlined strategic goals in 2019 to develop the region, including Hong Kong, Macao and nine cities in Guangdong province, as a global innovation hub.

"According to the report, CUHK accounts for nearly 6% of all research and development in an economy that is larger than South Korea," Pro-Vice-Chancellor (Research) Professor Sham Mai-har said at the launch of the report on 20 May. "The data tells us that we do the highest quality work. This is an impressive achievement for a university which only really got into intensive research in the 1990s."

The report, "Driving innovation in the Guangdong-Hong Kong-Macao Greater Bay Area: Research

impact and contribution by the Chinese University of Hong Kong", starts off by examining megatrends that drove research impact in the GBA between 2018 and 2022 and examines the impact across a range of key metrics spanning citations, knowledge exchange potential and research collaborations, before zooming in on CUHK's performance.

Elsevier uses bibliometrics from its abstract and citation database Scopus, which consolidates information from more than 7,000 international publishers.

The findings show that, on the whole, research and development in the GBA recorded compound annual growth of 17.9% in those five years, higher than the growth rates of China and the world. Its research output doubled from just under 74,000 publications in 2018 to nearly 143,000 in 2022.

"This report demonstrates the GBA's phenomenal growth as a research and development powerhouse," Professor Sham added. "If the GBA is going to take the next step and contribute to the development of the New Quality Productive Forces, this report is a powerful reminder that a strong research sector will be essential to that endeavour." The term "new quality productive forces" refers to China's emphasis on scientific and technological innovation.

Hong Kong: a pillar of GBA research

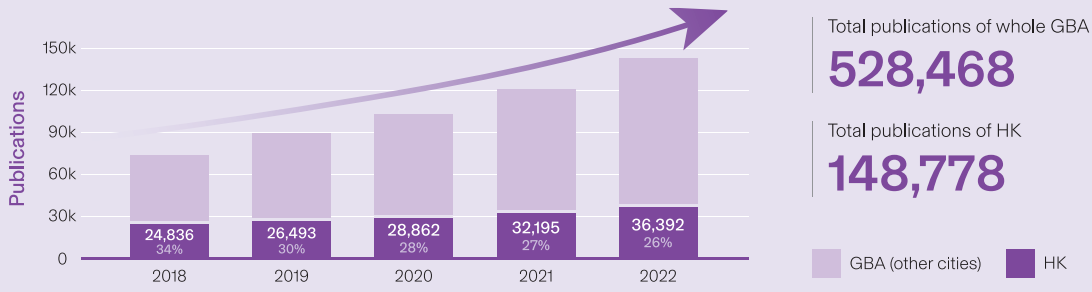
Hong Kong plays a significant role in the GBA's growth as a research and innovation powerhouse in China. It accounted for about 28% of total research output from the region, where roughly 16% of active researchers, numbering 66,900, were affiliated with institutions in the city, the report finds.

HK's contribution to GBA output

28%

Both Hong Kong and the overall GBA published extensively in the subject fields of computer science, chemistry, materials science, and engineering. In addition, Hong Kong researchers were also productive in subfields such as civil and structural engineering, and renewable energy, sustainability and the environment. These are not dominant subjects in the overall GBA region, where electronic, optical and magnetic materials and condensed matter physics were more present instead.

Research output of GBA and HK, 2018-2022 *Source: Scopus*



Closer analysis reveals CUHK contributed 5.4% to the GBA's total research output and 7.4% to its excellent research output, which is defined by publication in the world's top 1% of high-impact journals indexed in Scopus.

CUHK tops the chart in scholarly impact

On research impact, Hong Kong's output had a field-weighted citation impact (FWCI) of 1.9, meaning its work was 90% more cited than the world average. The city's FWCI was also 27% higher than the GBA's 1.5. FWCI is calculated by comparing the number of citations actually received by a publication with the number of citations expected for a publication of the same type, year and subject.

Five out of the 10 top-performing institutions in the GBA were based in Hong Kong. Crucially, CUHK had the highest overall FWCI in the entire region. Going by individual subjects, its impact scores also came first in medicine and computer science.

Furthermore, the report mapped research in the GBA against five fields of national strategic importance to assess the region's contribution to national development. It examined performance in biomedicine, environmental science, clean energy, artificial intelligence and quantum technology.

Among the five areas, CUHK made its largest research output in biomedicine, accounting for 5.3% of all such research in the GBA, and it achieved a higher contribution in the field of artificial intelligence, accounting for 5.8% of the research output in the GBA. The varsity's FWCIs in all five strategic areas also eclipsed averages across the region.

In terms of the size and mode of research collaborations, the report finds that the GBA conducted 30.2% of its joint studies with international partners. This figure was 41.1% for Hong Kong overall and 42.9% for CUHK, indicating the

CUHK's Pro-Vice-Chancellor (Research) Professor Sham Mai-har gives a speech at the launch of the Elsevier report at the CUHK Shenzhen Research Institute

strength of the university's research collaborations relative to peers in Hong Kong and the wider region. Nearly 40% of CUHK's research output involved the participation of GBA institutions, among which 60% involved co-authorship of institutions beyond the region as well, indicating the University's commitment to bridging the region with its partners further afield.

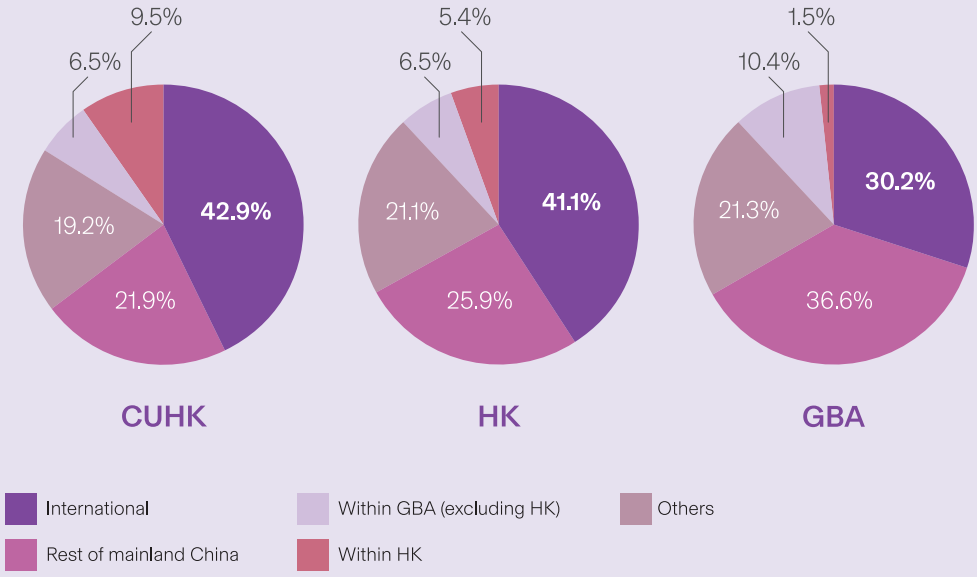
Professor Sham said the analysis "points to Hong Kong's role as a super connector and echoes the central government's call for Hong Kong to position itself as a uniquely international innovation and technology hub. CUHK will redouble its efforts to ensure that it acts as a true bridge between the mainland and the world, and these numbers are a powerful reminder of the importance of our historic mission 'to connect China and the West'."

The Elsevier report was launched at a special event at the CUHK Shenzhen Research Institute. The event featured a keynote address from Huawei's vice-president of global technical cooperation Dr Ai Chao and a panel session with representatives from the Shenzhen government and a CUHK startup.

Elsevier report

(From left) Professor Sham moderating a panel discussion with Professor Chen Li, Associate Professor of the CUHK Centre for China Studies, Mr Felix Lam, a startup representative from the CUHK Shenzhen Research Institute, Dr Xin Lan, Deputy Director of Nanshan District Innovation Department Promotion Centre, and Ms Lynn Li, President of Elsevier (Greater China)

Research collaborations of CUHK, HK and GBA, 2018-2022 *Source: Scopus*



Appointments

University officers and senior staff

Professor Yam Yeung

Mr Kenneth Chen Wei-on

Professor Xi Chao

Professor Anthony
Fung Ying-him

Professor Dennis Lo Yuk-ming

Professor Anthony
Chan Tak-cheung

Professor Chan Wai-yee

Professor Nick Rawlins

Professor Zhou Lin

Professor Hector
Chan Sun-on

Mrs Amelia Wong
Chan Wai-ping

Professor Song Chunshan

University officers and senior staff

		Name	Period
New	Master of Lee Woo Sing College	Professor Yam Yeung	1.7.2024 – 30.6.2028
	Vice-President (Administration)	Mr Kenneth Chen Wei-on	16.9.2024 – 15.9.2027
	Dean of the Faculty of Law	Professor Xi Chao	1.11.2024 – 31.10.2029
	Dean of the Faculty of Social Science	Professor Anthony Fung Ying-him	11.11.2024 – 10.11.2029
	Vice-Chancellor	Professor Dennis Lo Yuk-ming	8.1.2025 - 7.1.2030
Re-appointed	Pro-Vice-Chancellor / Vice-President (Alumni Relations & Advancement)	Professor Anthony Chan Tak-cheung	1.8.2024 – 31.7.2027
	Pro-Vice-Chancellor / Vice-President (Strategic Developments)	Professor Chan Wai-yee	1.8.2024 – 31.7.2025
	Pro-Vice-Chancellor / Vice-President (Student Experience)	Professor Nick Rawlins	1.8.2024 – 31.7.2025
	Dean of the Faculty of Business Administration	Professor Zhou Lin	9.12.2024 – 8.12.2029
	Head of New Asia College	Professor Hector Chan Sun-on	1.1.2025 – 31.12.2028
	University Secretary	Mrs Amelia Wong Chan Wai-ping	from 1.1.2025
	Dean of the Faculty of Science	Professor Song Chunshan	15.7.2025 – 14.7.2030

Emeritus professors

6.4.2024	1.9.2024	1.1.2025
		
Professor Paul Lai Bo-san Department of Surgery	Professor Xie Zuowei Department of Chemistry	Professor Ng Mee-kam Department of Geography and Resource Management

all appointments accurate as of 30 November 2024

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