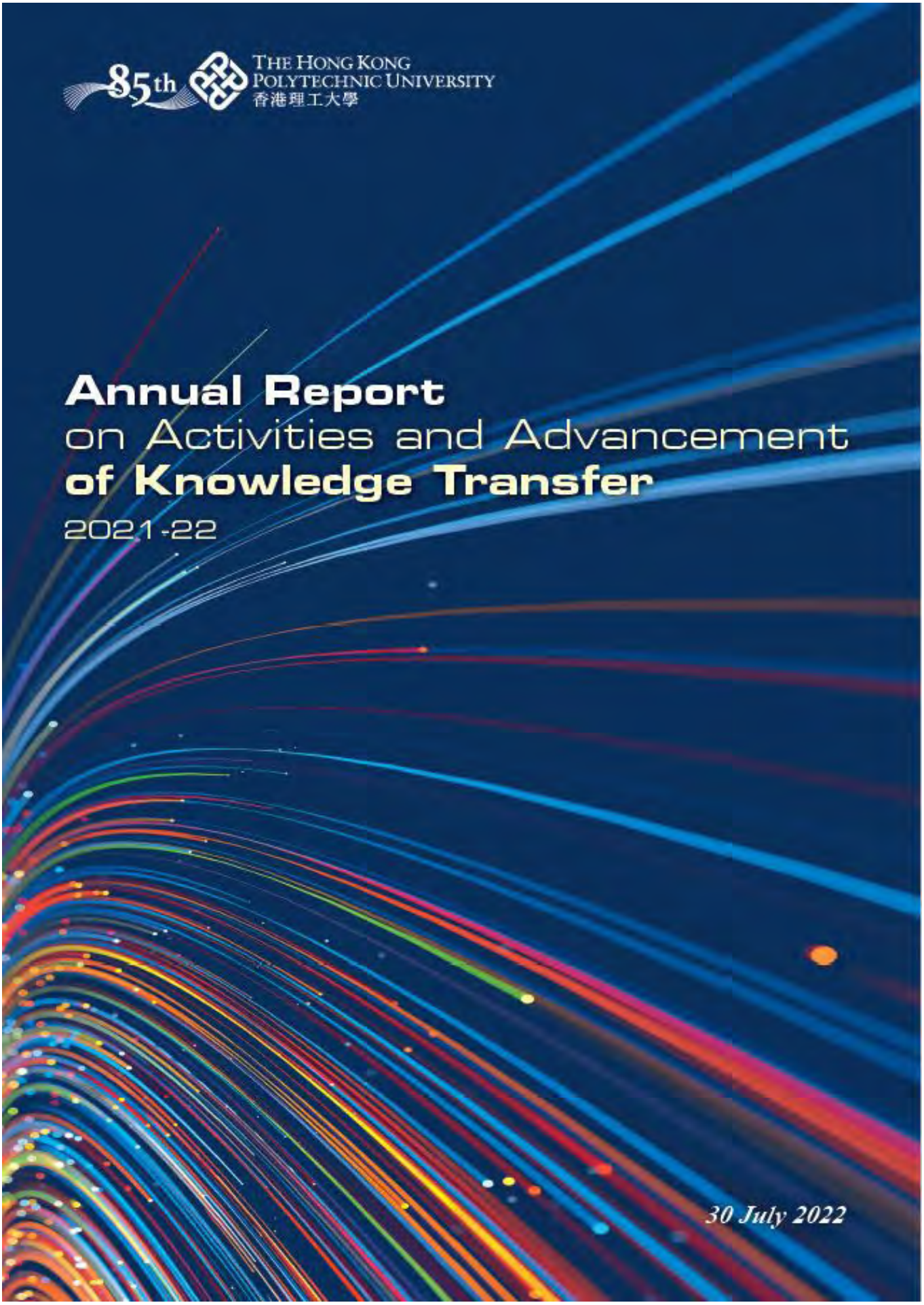
85th
THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學
Annual Report
on Activities and Advancement
of Knowledge Transfer
2021-22
30 July 2022

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1. EXECUTIVE SUMMARY

The fiscal year 2021/22 has been fruitful for The Hong Kong Polytechnic University (PolyU, the University) in its knowledge transfer (KT) and entrepreneurship endeavours. This report summarises the major activities and achievements of the University in transferring its innovations and technologies to create societal impact for the year ended 30 June 2022.

PolyU has a long history of striving for research excellence and transforming innovative ideas and research breakthroughs into real-world solutions addressing key societal challenges. To strengthen the foundation and infrastructure for interdisciplinary research, the PolyU Academy for Interdisciplinary Research (PAIR) has been expanded to 16 constituent units, making it the largest research platform of its kind in Hong Kong and the Greater Bay Area (GBA). To support the government's InnoHK initiative, PolyU has jointly established four research centres with world-leading institutions to conduct impactful collaborative research that will bring good to humankind.

To create an environment conducive to KT and entrepreneurship, the University has created a number of support mechanisms ranging from recognition and funding, to policies and guidelines. These include the President's Awards for Outstanding Achievement in Knowledge Transfer, the Young Innovative Researcher Award, and the Endowed Young Scholars Scheme. The University has also brought in a more flexible intellectual property (IP) licensing and assignment framework to encourage IPs with practical value to leave campus to create societal impact. As of 2021/22, a total of 162 IP licenses had been granted, close to 10% increase from that of the previous year. Income from such IP commercialisation reached HK$11.1 million for the year, a 52% year-on-year increase. The total number of active academic-led start-ups has almost doubled from 15 last year to 29 this year. More details can be found in section 2.

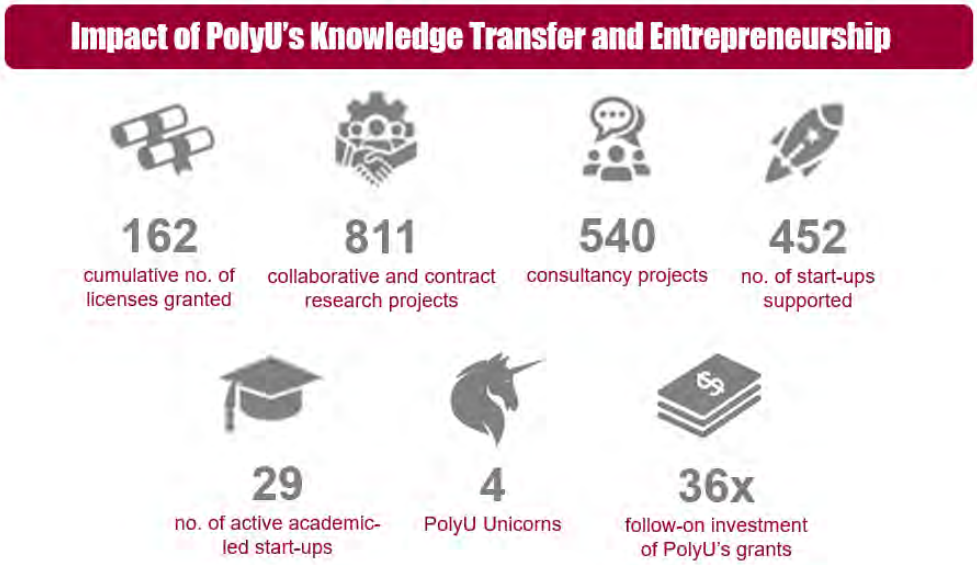
During the unprecedented fifth wave of the COVID-19 pandemic, PolyU continued to make concerted efforts to combat the virus and safeguard public health. PolyU's anti-pandemic contributions included modelling platforms to predict how the pandemic would develop, evaluation tools to help formulate policy, portable devices to detect the virus and antibody, and the world's first anti-virus 3D printing material. PolyU researchers have also developed a number of cutting-edge patented technologies, contributing to Hong Kong's development as a smart city. PolyU is also devoted to addressing local and regional environmental issues and advancing decarbonisation technologies for a vibrant and sustainable society, with its innovative and award-winning technologies being applied in Hong Kong and the GBA. PolyU's research capabilities in these areas have been reinforced by being awarded the most projects and highest amount of funding from the Environment and Conservation Fund (ECF) 2021/22 among all local universities. More details of PolyU's impactful research and innovations can be found in section 3.

To support Hong Kong's development into an international innovation and technology hub, the University has rolled out its "PolyVentures" initiative in partnership with industry and investors to help translate PolyU's research outcomes into real-world impact. The entrepreneurship development framework under the initiative was enhanced with a domain-based strategy focusing on Health, Sustainability (Textiles), Digital (Fintech/Web 3.0) and Manufacturing (Robotics), supporting start-ups at different stages from education and incubation, to accelerating and strengthening their development. As of 2021/22, PolyU has nurtured a total of 452 start-ups, of which 225 are tech start-ups and 227 are start-ups engaged in social/design innovations. Overall, PolyU-supported start-ups have raised 36 times follow-on external investment after receiving funding support from the University. Of the 18 unicorns on the "Hong Kong Unicorns List 2021", four are directly supported by PolyU entrepreneurship programmes or were co-founded by PolyU graduates. More details about PolyU's entrepreneurship ecosystem can be found in section 4.

The University's motto of "To learn and to apply, for the benefit of mankind" has also been demonstrated in its social innovations and service-learning pedagogy. During the past year, PolyU students delivered several impactful projects that benefitted the local community and beyond by incorporating design-focused thinking and social innovations. The service-learning component in PolyU's holistic education curriculum earned the University the honour of Teaching and Learning Strategy of the Year at the THE Awards Asia 2022, the only university in Hong Kong to receive a THE award out of nearly 500 worldwide entries. More details can be found in section 5.

Finally, the success of PolyU's KT and entrepreneurship development could not have been achieved without seamless collaboration with our strategic partners. In the past year, PolyU has formed more partnerships with governments, public organisations, industry associations and enterprises to broaden the collaboration network and enhance synergies for greater societal impact. For more details, please refer to section 6.

In summary, PolyU's achievements in KT and entrepreneurship are illustrated as follows:



2. PURSUING EXCELLENCE IN INTERDISCIPLINARY RESEARCH AND INNOVATION

With its vision to be a leading university that advances and transfers knowledge, PolyU has been propelling developments in education, research and knowledge transfer. It has built up a conducive environment to accelerate the translation of innovations and technologies from the University to society to create greater impact.

2.1. Grooming Young Innovators

PolyU launched the Undergraduate Research and Innovation Scheme in the 2021/22 academic year to engage the younger generation's interest in scientific research, and nurture the next generation of researchers and innovators. The newly launched Scheme advocates inquiry-based learning and provides full-time undergraduate students at PolyU with the opportunity to conduct research projects under the supervision of the University's scholars. The University will provide a range of support for students who enroll in the Scheme, which combines knowledge application and innovative ideas, including training, seminars, lectures by renowned researchers, as well as scholarships and small research grants that last for up to two years. Participating students will also be automatically admitted to the virtual College of Undergraduate Researchers and Innovators, which facilitates and encourages interdisciplinary studies among students. More than 100 undergraduate students have been selected to conduct individual or group research for the first cohort of the Scheme in the 2021/22 academic year.

2.2. Strengthening Infrastructure for Research Excellence

Expanding the Interdisciplinary Collaborative Platform for Greater Synergies

The University has been enhancing its foundation and infrastructure to advance mission-driven interdisciplinary research and knowledge transfer. The PolyU Academy for Interdisciplinary Research (PAIR) was established with the aim of developing impactful solutions for the greater good of society through advanced research and knowledge transfer activities. As of June 2022, PAIR has expanded to include 11 research institutes and five research centres, making it the largest research platform of its kind in Hong Kong and the GBA. This expansion will increase the synergies that underpin the University's research development, and open new horizons with innovative solutions that address global challenges.

PAIR Inauguration Ceremony at PolyU InnoTech Open Day held at 16 July 2022

• Mental Health Research Centre • Photonics Research Institute • Research Centre for Chinese Medicine Innovation • Research Centre for Deep Space Explorations • Research Centre for Resources Engineering towards Carbon Neutrality • Research Centre for SHARP Vision • Research Institute for Advanced Manufacturing • Research Institute for Artificial Intelligence of Things	• Research Institute for Future Food • Research Institute for Intelligent Wearable Systems • Research Institute for Land and Space • Research Institute for Smart Ageing • Research Institute for Smart Energy • Research Institute for Sports Science and Technology • Research Institute for Sustainable Urban Development • Smart Cities Research Institute

Collaborating with World-leading Institutions to Support the InnoHK Initiative

In support of the Hong Kong government's InnoHK initiative, which aims to develop Hong Kong as a hub for global research collaboration, PolyU has joined forces with world-leading institutions to develop research centres under two newly established research clusters – AIR@InnoHK (focusing on artificial intelligence and robotics technologies) and Health@InnoHK (focusing on healthcare-related technologies). Three research centres led by PolyU have been admitted to the initiative: the *Laboratory for Artificial Intelligence in Design (AiDLab)*, the *Centre for Advances in Reliability and Safety (CAiRS)* and the *Centre for Eye and Vision Research (CEVR).* PolyU is also a collaborating institution in another, the *Centre for Artificial Intelligence and Robotics, Hong Kong Institute of Science & Innovation, Chinese Academy of Sciences.* These research centres pool researchers from all over the world to conduct impactful collaborative research that will bring good to humankind.

AiDLab

CAiRS

CEVR

Partnering with Industry Leaders to Establish Joint Laboratories

In addition to academic collaborations, PolyU has also partnered with leading industry organisations. The world's first *Joint Research Laboratory for Probiotics and Prebiotics in Human Health* was established with a HK$2 million donation from Hong Kong Yakult Co. Ltd. The Joint Research Laboratory will leverage PolyU's strengths and expertise in food safety and technology to conduct impactful interdisciplinary research in probiotics and prebiotics to improve human health, focusing on areas such as gut health, brain health, women's health, and eczema.

To strengthen innovation and technology development and cultivate talent in artificial intelligence (AI), PolyU and Huawei Hong Kong have formed a partnership to create an AI research platform to translate research output into real-world applications, contributing to the development of an AI ecosystem. Both parties will establish a joint AI laboratory to empower students with the most advanced AI technology in their pursuit of scientific research and industrial innovation. The laboratory will also run courses in AI, cloud computing, big data, and the Internet of Things (IoT) to meet the surging demand for innovation and technology talents in Hong Kong.

Establishing Research Institutes and Centres in the Mainland to Strengthen Collaboration

To strengthen collaboration with the Mainland and support the translation and application of PolyU's research outcomes to a wider population, the University is committed to establishing research institutes and centres in Mainland China as part of its knowledge transfer (KT) strategies.

In 2020, PolyU and the Shenzhen Power Supply Bureau jointly established the first low-voltage innovation laboratory platform in China, integrating the power grid system and electrical systems of buildings. Based on a full-size experimental model and a computer simulation system, the platform conducted a series of research studies and formed a set of intelligent

cloud monitoring systems to identify the hidden public safety dangers of power distribution. As of April 2022, the platform has completed the construction and operation of 547 smart stations, covering 11,568 indoor and outdoor low-voltage branches.

Besides its long-established Shenzhen Research Institute in Nanshan District, PolyU has recently established a new research institute in Futian District, *The PolyU-Shenzhen Technology and Innovation Research Institute (Futian)*, to leverage opportunities offered by the development of the GBA. The Research Institute will run research projects supported by the Shenzhen-Hong Kong Science and Technology Innovation Cooperation Zone (Pilot Scheme), adding impetus to the impactful research produced by PolyU.

2.3. Providing Institutional Recognition and Financial Support for Knowledge Transfer

President's Awards for Outstanding Achievement in Knowledge Transfer

Awards presentation at the PolyU InnoTech Open Day

To recognise staff endeavours in knowledge transfer, in 2021 PolyU launched the inaugural President's Awards for Outstanding Achievement in Knowledge Transfer. The Awards include two sub-categories: Industry, for projects demonstrating contributions in advancing industry; and Society, for developing or enhancing the well-being of society. Forty nominations were received from eight faculties and schools, and ten impactful cases were awarded after a rigorous assessment process. The winning individuals or teams will receive a KT grant to further develop and apply their technologies or innovations. To publicise the ten impactful innovations, a dedicated webpage and a total of 13 videos were produced, and were promoted on social media platforms. Details of the awardees and their projects can be found at Appendix 2.

Young Innovative Researcher Award (YIRA)

The University has also introduced the YIRA to honour young PolyU researchers under the age of 35 who have demonstrated novelty, contributed to technology advancement, and propelled transformational innovation into solutions for addressing problems in society. In the inaugural round of the Award in 2022, 59 submissions were received from 22 departments, and six YIRA awardees were selected. Each awardee will receive funding support to encourage and further advance their research for greater impact.

Endowed Young Scholars Scheme (EYSS)

This newly launched scheme aims to partner with donors to support promising early-career academics in driving innovations that bring positive, long-term changes to the world. Since its inception in July 2021, six outstanding young scholars have been appointed in the areas of aerospace navigation, advanced textiles technologies, civil engineering, medical laboratory science, smart robotics and social services.

Departmental Outcome-Oriented Key Performance Indicator (DoKPI)

As part of the University's KT strategies to align departmental and individual performance measures to better reflect a congruent value system, a DoKPI on Practical Impact has been officially regarded as a KPI for assessing the performance of academic units on KT starting from 2020/21, in addition to those KPIs set by the University Grants Committee. The first full implementation of the DoKPIs for academic units was completed in February 2022.

2.4. Liberalising Policies and Guidelines to Facilitate Knowledge Transfer

PolyU has been liberalising relevant policies and guidelines to provide institutional support at all levels to develop an environment that incentivises the full realisation of its KT and entrepreneurial potential.

The University has relaxed the ownership of intellectual properties (IPs) created by non-research students who are not significantly using University resources. The IP filing process has also been expedited and enhanced: more patent firms

have been appointed, thus expanding the number of service providers, the filing of Chinese patent applications could be handled directly in the Mainland instead of through agents based in Hong Kong. This has improved the quality and efficiency of Chinese patent filing. PolyU has brought in a more flexible IP licensing and assignment framework to encourage IPs of practical value to leave campus to create societal impact. The framework enables favourable arrangements for academic-led or student-led start-ups to reduce the initial financial burden and support their development. So far, this new framework has supported eight academic-led start-ups.

To support academic entrepreneurship, the University has also enhanced supportive measures to facilitate the creation of academic-led start-ups. More flexible policies and guidelines will be provided for the academics to engage in KT and entrepreneurial activities, and facilitate their start-ups during market validation and commercialisation of the University's IPs.

3. TRANSFERRING INNOVATIONS AND TECHNOLOGIES FOR GREATER IMPACT

3.1. Combating COVID-19 and Safeguarding Public Health

Since the beginning of the COVID-19 pandemic, researchers at PolyU have been applying their knowledge and innovations to help combat the virus and safeguard public health. PolyU anti-pandemic contributions include modelling platforms to predict how the pandemic will develop, evaluation tools to help formulate policy, devices to detect the virus, and anti-virus 3D printing material.

Spatial Prediction of COVID-19 Onset Risk Using Big Data

Predicting the spatiotemporal risk of COVID-19 onset, which is different from the risk in terms of confirmed cases, is essential for timely anti-epidemic measures. A research team led by Professor SHI Wenzhong, Director of PolyU's Smart Cities Research Institute (SCRI), have developed an extended Weighted Kernel Density Model and Spatiotemporal Big Data Platform that can show the latest developments and short-term forecasts for the onset of COVID-19 symptoms. The team has been using locally-generated big data, such as the location of patients, time of diagnosis and development of symptoms, population mobility, vaccination rate, and a social distancing index to identify high-risk areas within a specific time period. The platform has a prediction accuracy of more than 85% for the following three days. By predicting the development trend of the epidemic more quickly, the platform enables public health officials to formulate more precise prevention and control strategies.

Evaluation Tools for Analysing the Effectiveness of Social Distancing Policies and International Border Control

Professor CHEN Wu (middle) and his team developed a mobile app with a contact tracing feature for use by inbound travellers.

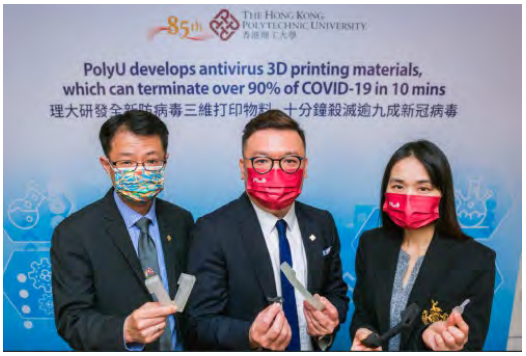
Social distancing is a key non-medical intervention to control the spread of COVID-19 and is a crucial strategy to mitigate the pandemic. Professor CHEN Wu, Head and Professor of the Department of Land Surveying and Geo-Informatics at PolyU, and his research team were engaged by Logistics and Supply Chain MultiTech R&D Centre to develop evaluation tools to analyse the effectiveness of social distancing policies and international border control for the spread of COVID-19. Using a computational approach to analyse scenarios of different vaccination coverage based on demographic data such as age group and geographic location, they forecast the pandemic spread rate based on different prevention policies in Hong Kong and in major countries with potential visitors to Hong Kong. The team also developed effective tracking methods for inbound visitors and evaluated the effectiveness of geo-fencing methods. The evaluations will provide critical tools to support the Government's decision to enable digital contact tracing using location-based devices (e.g. mobile phones and tracking wristbands). This makes epidemiological investigation highly efficient as the follow-up notification process can be in near real-time as new cases are confirmed. Optimal geo-fencing strategies can then be put in place to control the spread of the disease more effectively. More details can be found in Appendix 4.

Portable Nucleic Acid Testing Device Enables Fast and Accurate Results On-site

A PolyU interdisciplinary research team led by Professor YIP Shea-ping (Head and Chair Professor of the Department of Health Technology and Informatics) and Dr LEE Ming Hung Thomas (Associate Head and Associate Professor of the Department of Biomedical Engineering) has developed a portable testing device for COVID-19 funded by the Health and Medical Research Fund (HMRF). The entire test can be completed in about 40 minutes on-site without the need to return samples to a laboratory. The clinical sample (purified nucleic acid) test results were in full agreement with the reverse transcription–polymerase chain reaction (RT-PCR) standard. More details can be found in Appendix 4.

The portable and built-in power bank-operated device

Recognising PolyU's research capabilities, the HRMF granted HK$55.9 million to PolyU in September 2021 to start work on two large-scale, cross-disciplinary COVID-19 studies. The two new studies will explore "a community-based participatory research approach to reduce the COVID-19 risk in Hong Kong" by developing and testing social and behavioural interventions (HK$27.6 million) and "the Prevention-Protection-Promotion approach as a novel and effective strategy to prevent infection and enhance recovery in individuals with COVID-19" (HK$28.3 million). These studies will better prepare Hong Kong for the recovery stage of the COVID-19 pandemic.



Dr LO (middle) and his team developed the anti-virus material.

World's First Anti-virus 3D Printing Material

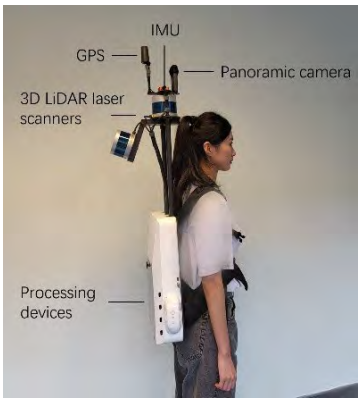
An interdisciplinary research team led by Dr Kwan Yu Chris LO, Associate Professor of the Institute of Textiles & Clothing (now renamed as School of Fashion and Textiles), has developed the world's first anti-virus 3D printing material that can kill COVID-19. The material is made from resin, with anti-viral agents such as cationic compounds, which are added to damage the membrane of the virus and destroy its structure. Using 3D printing, the material can be produced in a variety of different forms. The research team has started a project to collaborate with the Sham Shui Po District Office to produce protective doorknob covers for over 100 unmanaged "Three-Nil" buildings in the district and install these covers on doors frequently used by residents to reduce the risk of virus transmission in buildings. The team will also apply the material in primary and secondary schools, healthcare facilities, and public transportation systems.

3.2. Contributing to Smart City Development in Hong Kong

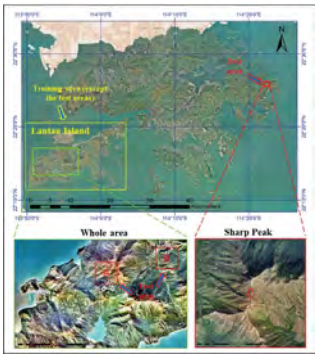
To support the "Hong Kong Smart City Blueprint 2.0" initiative, Professor SHI Wenzhong, Director of the PolyU Smart Cities Research Institute (SCRI), led a team that has developed a number of cutting-edge patented technologies to help address a number of social issues, including the revitalisation of old buildings, slope safety, and the construction of spatial data infrastructure. They hope to provide comprehensive solutions for smart city development in Hong Kong.

3D Mobile Mapping System: Providing Accurate 3D Maps to Support Wide Smart City Applications

Today's construction industry is moving towards Modular Integrated Construction (MiC). Recognising this, the PolyU team has developed a lightweight and reliable 3D mobile mapping system in the form of a mobile mapping backpack which can easily measure cities and produce 3D maps to centimetre-level accuracy. The team worked in collaboration with the Hong Kong Construction Industry Council by using the mobile mapping backpack to accurately measure critical narrow road sections in 3D to identify the location of obstacles. This can help optimise a route for transporting oversized components from manufacturing factory to construction site to install in a building. The mobile mapping backpacks can also be used to help obtain detailed indoor 3D models to support firefighting and provide evacuation routes for personnel at the scene of a fire.



3D mobile mapping system (or the "mobile mapping backpack")



Study areas on Lantau Island and Sharp Peak, Hong Kong.

AI-based Landslide Recognition: Reporting Landslides and Facilitating Disaster Control

A long-standing challenge for smart city construction is accurate and timely acquisition and update of spatial data infrastructure from remotely sensed big data. Professor SHI's team has developed a series of AI-based algorithms to recognise various ground objects from remotely sensed data with greater accuracy and reliability. This supports the work of smart government in many areas such as urban planning and disaster mitigation. A software system integrating these AI algorithms helps the Hong Kong Civil Engineering and Development Department quickly and automatically recognise and locate landslides, a major natural hazard in Hong Kong. With the ability to accurately identify up to 90% of essential information about a landslide such as its shape, area, height and trail, this provides important technical support for landslide control.

3.3. Fostering Sustainability and Energy Efficiency

To support the Government's goal for Hong Kong to reach carbon neutrality by 2050, PolyU has expended concerted efforts to address local and regional environmental issues and advance decarbonisation technologies for a vibrant and sustainable society.

Responsive Web-based Solar Irradiation Map with Solar Energy Calculator for Hong Kong

Professor Charles WONG of the Department of Land Surveying and Geo-Informatics won a silver medal at the 2022 Geneva Inventions Expo. The winning project, supported by the Electrical and Mechanical Services Department (EMSD) of the HKSAR Government, was designed to increase the penetration of renewable energy in Hong Kong, specifically solar energy. The owners of suitable buildings are already encouraged to install a rooftop solar photovoltaic (PV) system and sell the electricity it generates to the power company serving their area. Professor WONG's web-based Hong Kong Solar Irradiation Map (https://solarmap.emsd.gov.hk/map) uses a Geographic Information System (GIS) to analyse numerous criteria, including the slope, site obstruction, shadow effect and barriers, enabling anyone to identify appropriate locations, orientation and tilting angle for installing a PV system. The map provides estimated information about average annual solar irradiation, the area suitable for installing PV panels, installation capacity, annual electricity generation, and annual return on income from the Feed-in Tariff scheme.

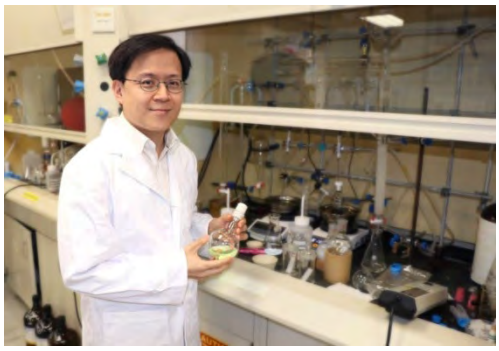
A Hybrid Statistical Model Improving Manufacturing Efficiency and Minimising Environmental Footprint

Textile manufacturers often encounter delivery shortfalls or wasted resources and energy due to inaccurate estimates of the raw materials they require, and poor production planning. Dr JIANG Binyan and Dr HE Daihai, Associate Professors of the Department of Applied Mathematics, and a team of researchers have developed a hybrid statistical model that can accurately predict the product qualification rate and adjust the machine output value based on the condition of raw materials, thus reducing the waste of both materials and energy. Using this hybrid statistical model, Dr JIANG and his team developed software which can be used in a factory to help automate the production process. The model has helped a global textile manufacturer improve production efficiency and reduce production costs by HK$2.5M annually. It has also reduced power consumption by 201,670 KWh, and minimised its environmental footprint by eliminating 300 tons of greenhouse gas emissions and 2,155 tons of sewage annually.

More Research Projects to Tackle Global Environmental Challenges

PolyU has achieved excellent results in the Environment and Conservation Fund (ECF) 2021-22 funding exercise for Environmental Research, Technology Demonstration and Conference Projects. Of the 41 research projects awarded to local UGC-funded universities, PolyU was awarded the most projects and topped the amount of funding granted. In total, the University received HK$10 million in funding from the ECF, supporting 13 research projects. These included a study of how high purity oxygen can enhance sewage treatment, a study using remote sensing technology and AI to monitor oil spills

at sea, a study producing hydrogen while using solar power to purify waste water, and a study developing a smart robot that can pick up and sort litter in difficult terrain.



Professor WONG's team hopes to develop technologies that meet the world's future energy demand.

PolyU is also the only Hong Kong institution granted the "National Key R&D Program – International Science and Technology Cooperation Project" in its 2021 exercise. The granted research project "Development of new, stable, highly-efficient blue emissive materials that can be processed by wet methods and the associated large-area solid-state lighting technologies" is led by Professor Raymond WONG, Dean of the Faculty of Science, Clarea Au Professor in Energy, and Chair Professor of Chemical Technology of the Department of Applied Biology and Chemical Technology. This project aims to enhance the industrialisation of solution-processed white organic light-emitting diodes (WOLEDs), a new generation of potential energy-saving lighting devices, with the advantages of high material utilization, high energy efficiency, low manufacturing costs, and ease of large-area fabrication. More details can be found in Appendix 4.

3.4. Contributing to Technology Development in the GBA

PolyU's innovative research and technologies have benefitted not only the local community in Hong Kong, but also the GBA. With the rapid development and further integration of Hong Kong and adjacent cities in the GBA, more collaborations will be forged to strengthen technology transfer and development in the region.

Award-winning Novel Rail Damper in Trial Use on Shenzhen Metro

The Modular Rail Particle Damper (MRPD) is a new rail damper developed by the Hong Kong branch of the Chinese National Rail Transit Electrification and Automation Engineering Technology Research Centre (CNERC-Rail) at PolyU. It was awarded third prize from nearly 400 participating institutions in the Innovation and Entrepreneurship Competition organised by the National Innovation Centre of High Speed Train, and the Qingdao Rail Transit Industry Demonstration Zone Management, China. More details can be found in Appendix 4.

In-situ MRPD performance test in Shenzhen Metro Line

Developed by a research team led by Professor NI Yiqing, Yim, Mak, Kwok & Chung Professor in Smart Structures, Chair Professor of Smart Structures and Rail Transit of the Department of Civil and Environmental Engineering, and Director of CNERC-Rail, the MRPD can mitigate and control noise and vibration in rail transit systems by employing a novel approach using rail particle damping technology and an advanced machine learning algorithm. The new dampers were installed for trial use at a viaduct section of the Shenzhen Metro in January 2022 and will later be extended to other urban rail transit systems in China.

PolyU Researcher Undertaking Technology Project First Launched in Hong Kong and Macao

PolyU is the only Hong Kong institutional recipient in the first open call from the China Southern Power Grid Corporation (World Fortune Top 100 Company) for the Hong Kong and Macao joint inter-institutional research scheme to address common problems of power grid operation in core cities of the GBA.

Led by Professor XU Zhao of the Research Institute of Smart Energy (RISE) and also the Department of Electrical Engineering, the project has been granted nearly CNY3.6 million to conduct "system inertia analysis and control for renewable penetrated power systems towards national dual carbon targets". The project will contribute to maintaining secure and stable operation of power grids, large-scale development and utilization of emerging energy technologies, and exploration of a long-term collaboration mechanism for scientific and technological innovation cooperation among Guangdong, Hong Kong and Macao. More details can be found in Appendix 4.

4. ENHANCING THE ENTREPRENEURSHIP DEVELOPMENT FRAMEWORK TO ACCELERATE KNOWLEDGE TRANSFER

4.1. The PolyVentures Initiative

As one of the top 100 universities in the world, PolyU strives to play a part in supporting Hong Kong's development into an international innovation and technology hub. The University has rolled out its "PolyVentures" initiative in partnership with industries and investors to help translate PolyU's research outcomes into real-world impacts. Specifically, an entrepreneurship development framework will be built to support start-ups at different stages from education and incubation, to accelerating and strengthening their development. In the past year, a domain-based strategy has been adopted to enhance the framework.

4.2. PolyU Unicorns

As of 2021/22, PolyU has nurtured a total of 452 start-ups: 225 tech start-ups and 227 start-ups focused on social/design innovations. Of the 18 unicorns on the "Hong Kong Unicorns List 2021", four are directly supported by PolyU entrepreneurship programmes or were co-founded by PolyU graduates. They are Hai Robotics, EcoFlow, Aftership and GOGOX.

Hai Robotics, founded in 2016 by Mr Richie CHEN and Mr FANG Bing, graduates of the Department of Electronic and Information Engineering of PolyU, is a start-up that provides world-leading autonomous case-handling robotic systems. With an entrepreneurship fund of HK$700,000 supported by PolyU at its early stage, Hai Robotics has now become an industry leader with more than 400 intellectual property rights and customers spanning over 20 countries. Through their intelligent warehouse automation systems and solutions, customers can increase warehouse storage density by 80% to 130%, and improve operational efficiency by a factor of three to four.

EcoFlow, founded in 2017 by Dr Bruce WANG, a graduate of the Department of Mechanical Engineering, provides industry-leading portable power solutions, solar technology, and the world's first smart home ecosystem. Since founding EcoFlow, Dr Wang has led a team carrying out research and development with a mission to reinvent how average people and families access energy. He is committed to building EcoFlow into a leading renewable energy solution provider across the globe. EcoFlow DELTA Pro, the world's first portable home battery, was named in TIME magazine's list of 'The Best Inventions of 2021".

Aftership was co-founded in 2012 by Mr Dante TSANG, who received seed funding from the PolyU Micro Fund Scheme. The start-up offers a suite of automation tools to help businesses with sales, marketing, order management, and shipment tracking. Their service allows online retailers to view the delivery status of their customers' packages in one place, and automatically notifies customers via SMS and email at critical times during the delivery process. This greatly reduces customer enquiries and generates more returning customers for online merchants.

GOGOX (formerly GOGOVan), co-founded by PolyU graduate Mr James O in 2013, is one of the first mobile app-based logistics platforms in Asia revitalising the traditional logistics industry with innovative technology. Over the years, GOGOX has expanded its business from Hong Kong to over 340 cities, with more than 4.5 million registered drivers in its network. Mr James O has been awarded the PolyU School of Design's Outstanding Alumni Award in Entrepreneurial Achievement.

4.3. Education and Ideation Programmes to Plant the Seed of Entrepreneurship

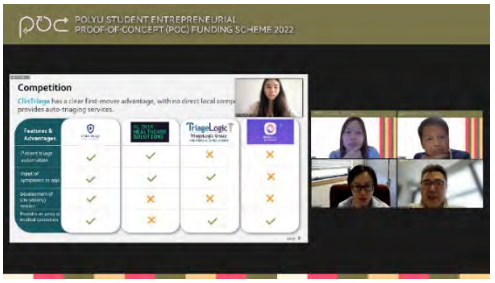
PolyU has long been incorporating entrepreneurship learning as a core component in its all-round educational model through credit-bearing courses and a wide range of extra-curricular activities. These highly experiential and action-based entrepreneurship education programmes have enhanced PolyU students' innovation capabilities and prepared them to become future entrepreneurs.

PolyHack: A Revolution of Hackathons

PolyU launched PolyHack to generate interest in entrepreneurship and create a sustainable series of student-initiated hackathons. In its founding year in 2022, PolyHack attracted more than 330 participants from 23 locations around the world, representing over 60 institutions and 46 projects. The theme of this year's global hackathon was "Life in 4.0", featuring three major domains: Blockchain, FinTech and Smart City. In the 14-day hackathon, 18 virtual events were held and 26 hours of individual team mentorship were provided by 13 working industry leaders with experience in a wide range of domains. Together, the participants and mentors explored innovative solutions and technologies that can be implemented to support the development of the new 3.0 era.

Proof-of-Concept (POC) Funding Scheme 2.0

The POC Scheme aims to instil a problem-driven innovation mind-set into young people with talent. The Scheme was recently enhanced to POC 2.0 to support the ideation and prototyping of student innovations, with a donation of HK$5 million from Dr Winnie TANG, Founder and Chairman of Esri China (Hong Kong) Limited. In 2021/22, the Scheme engaged 139 students and granted funding support to 38 projects. It also supports and prepares students to participate in local and overseas innovation and entrepreneurship competitions. The number of awards won by PolyU teams increased from 12 in 2020/21 to 29 in 2021/22, the highest number ever recorded.



Domain-Based Future Challenge Competitions

The University launched a series of domain-based entrepreneurship competitions called "PolyVentures Future Challenge" by leveraging its interdisciplinary research expertise and collaborations with our strategic partners. The purpose of these competitions is to drive impact and foster start-ups in focused domains including Smart City, Healthcare, and Sustainability. The competitions drew on PolyU's innovative research and the resources of different stakeholders such as students, researchers, alumni, and industry partners to co-innovate to solve problems facing society. The first round of the competition focused on the theme of Smart City, partnering with Hong Kong Telecom (HKT), Chinachem Group and Esri China (Hong Kong) Limited. The second round of the Health Future Challenge launched successfully, with over 200 participants forming 21 research teams and 31 student teams. The Sustainability Future Challenge in Textiles, co-organised with the PolyU School of Design, will launch in August 2022 in partnership with Hang Seng Bank.

Leveraging PolyVentures to grow PolyU's Entrepreneurship Community

In 2021/22, the PolyU Entrepreneurship Society (ES) recruited 124 new members to expand the entrepreneurship community, increasing the total membership to 772. The University hosted 16 entrepreneurship events through PolyU InnoHub, attracting over 1,200 participants and stimulating their interest in innovation and entrepreneurship. The PolyVentures Mentorship Programme was enhanced based on different domains to provide systematic support to PolyU start-ups. A total of 31 industry and professional mentors have been engaged to advise and guide PolyU start-ups at different stages of development.

4.4. Incubation Support to Nurture Growth and Development

PolyU Micro Fund (MF) Scheme 2.0

To support more young entrepreneurs and provide their start-ups with more incubation support, PolyU has partnered with the Hong Kong Science & Technology Parks Corporation (HKSTP) to enhance the Micro Fund (MF) 2.0 Scheme. The Scheme will help fast track PolyU entrepreneurs to enter HKSTP's ideation and incubation programmes. Besides the funding from the MF 2.0 Scheme, teams admitted to HKSTP's Ideation and Incubation Programmes will also receive additional funding support. The Scheme and the partnership will provide full support to students and graduates to commercialise their innovations and technologies and accelerate the development of their ventures at the start-up stage.

GBA Start-up Postdoc Programme

PolyU piloted the GBA Start-up Postdoc Programme in Shenzhen in 2019 to nurture research-based start-ups. This dual-track programme supports recent doctoral graduates to conduct translational research while pursuing technology entrepreneurship to turn their technologies into products or services under academic supervision and industry mentorship. Building on its success in Shenzhen, the Programme was extended to Hong Kong in 2022, boosting the number of admitted postdocs from six in 2020/21 to 20 in 2021/22.

4.5. Investment for Acceleration and Expansion

To groom start-ups that demonstrate potential to become signature ventures, PolyU has been leveraging its local and regional networks of mentors, investors, strategic partners, and investment funds to accelerate the growth and expansion of early-stage start-ups. The Entrepreneurship Investment Fund was set up with an initial investment pool and 38 investment partners. The University has been actively screening potential start-ups for investment review and consideration.

4.6. Awards and Recognitions

PolyU supported entrepreneurship teams and start-ups achieved good results in a number of prominent local, regional and global competitions. Grand Rise Technology, a start-up co-founded by Professor Pauline LI from the Department of Applied Biology and Chemical Technology, received the the China Functional Nanomaterials Best Investment Value Award (First Prize) in the CHInano 2021 Conference & Expo, entered the final round as the top 10 teams and won the Environmental Impact Award at JUMPSTARTER 2022, a leading start-up competition in the region. Two start-ups founded by PolyU alumni, namely eSix and viAct, also made it to top 100, among over 600 start-up participants from the globe.

Professor Pauline LI (left) at the JUMPSTARTER 2022 Award Presentation Ceremony

The awarded researchers: Dr Dahua SHOU (1st from left), Prof. Jing CAI (2nd from left) and Prof. Hong HU (3rd from left)

PolyU teams also won three prestigious global Innovation Awards in the areas of artificial intelligence (AI), materials science and biotechnology at the TechConnect World Innovation Conference and Expo 2022, the world's largest multi-sector event for fostering the development and commercialisation of innovations. This is the sixth consecutive year that PolyU research teams have snatched the esteemed awards among top-ranked innovators, and PolyU is the only higher education institution in Hong Kong to be honoured with the awards this year. The three winning innovations are AI-Empowered Chest X-Ray and CT Quantitative Analysis for COVID-19 Patient Management by Professor Jing CAI, Department of Health

Technology and Informatics; Moisture-Absorbing and Sweat-Releasing Multilayer Polylactic Acid Fabric and Manufacturing Technology by Professor Hong HU, the Institute of Textiles & Clothing; and Omni-Cool-Breath: A Smart Air-Conditioned Mask by Dr Dahua SHOU, Professor FAN Jintu and Dr HUANG Guanghan, Institute of Textiles and Clothing.

PolyU also garnered six awards in the International Exhibition of Inventions of Geneva 2022, an important global event devoted to inventions, including one Gold Medal with Congratulations of the Jury, one Gold Medal, three Silver Medals and one Bronze Medal.

5. SOCIAL INNOVATIONS FOR THE BENEFIT OF THE COMMUNITY AND THE GLOBE

5.1. Enhancing Age-friendliness in the Food & Beverage Industry

PolyU Jockey Club Design Institute for Social Innovation (JCDISI) compiled "The Toolkit for the Age-friendly Community Kitchen" based on a field study conducted with the support of the Tung Wah Group of Hospitals' community kitchen to better understand the working environment of the catering industry. The project was a collaboration with the School of Design, the Department of Applied Social Science, and the Jockey Club Smart Ageing Hub at the Department of Biomedical Engineering. The toolkit illustrates a universal design approach with 119 design principles covering eight aspects of kitchen operation. Supported by the Occupational Safety & Health Council, the toolkit was distributed to industry members of the Catering & Hospitality Services Safety & Health Committee, helping to create a better working environment for the elderly and providing an operational model for an age-friendly community kitchen.

5.2. Envisioning a Socially-Inclusive Waste Management Hub

JCDISI prototyped a conceptual building design for a community waste management hub in collaboration with a team of professional architects from "Occurrence Design & Research", the labour organisation "Hong Kong Women Worker's Association", and the green group "Waste-No-Mall". The community waste management hub has not only integrated both refuse collection and recycling functions, its spatial planning design approach and operation model have also focused on meeting cleaners' daily needs by setting up a Staff Social Zone and Workers Bay. Nearby residents are also encouraged to use the community recycling and upcycling facilities. This prototype design won the Silver Award of The Hong Kong Institute of Planners Awards 2021.

5.3. Learning and Teaching Tools for the Future of Education

In recent years, JCDISI has been working closely with local schools to co-imagine education for the future. Over 150 workshops have been delivered aiming to foster social innovation and design thinking, reconnect knowledge to the real world, and transfer know-how to develop students' competencies for future challenges. About 180 educators and 600 students from 20 secondary schools have contributed to the project. The knowledge and experience we gained on the journey have been documented in a toolbox and a programme report. The toolbox contains valuable insights, innovative case studies, as well as the learning and teaching tools for innovative classrooms. It has been be distributed to secondary schools for teachers to bring social innovation and design thinking into classrooms for the future of learning.

5.4. Service-learning Projects for Societal Impact

PolyU was honoured to receive the award for Teaching and Learning Strategy of the Year at the THE Awards Asia 2022. From nearly 500 entries received from all over the world, PolyU was the only university in Hong Kong to be honoured with a THE award this year.

PolyU's service-learning programmes played an important role in winning the award. Service learning aims to develop students' social responsibility by serving the community using their classroom knowledge. Since its launch in 2012, PolyU has created a positive impact on the lives of many through service-learning subjects, ranging from installing solar electricity and water filtration systems, to performing eye examinations and teaching STEM subjects to hundreds of children. Even under the challenges of COVID-19, PolyU's service-learning programme continued to expand in 2021/22, with 4,437 students serving communities in Hong Kong, Mainland China, Taiwan, Rwanda, South Africa, India, Vietnam, Cambodia, the Philippines, Japan, Indonesia, and Thailand.

6. ENGAGING INNOVATION AND TECHNOLOGY ECOSYSTEM PARTNERS FOR KT AND IMPACT

PolyU has formed strategic partnerships in the innovation and technology ecosystem, including governments, public organisations, industry associations and enterprises. These strategic partnerships will create opportunities for knowledge transfer, strengthen the collaboration network and enhance synergies for greater impact.

Jiangsu-Hong Kong-Macao University Alliance (JHMUA)

The JHMUA was jointly established by Nanjing University, PolyU and the University of Macao in 2021. Its aim is to leverage the advantages of institutions in Jiangsu Province, Hong Kong and Macao to strengthen exchange and collaboration in areas such as talent cultivation, and research in innovation and technology. With the full support of the governments of the three regions, the JHMUA now consists of 33 member institutions, including 21 from Jiangsu Province, nine from Hong Kong and three from Macao.

The Hong Kong Applied Science and Technology Research Institute (ASTRI)

PolyU has signed a Memorandum of Understanding (MoU) with ASTRI to strengthen collaboration on research and technology transfer, and nurture future R&D talent by leveraging the research expertise of both parties. Under this MoU, PolyU's Department of Applied Physics and ASTRI will jointly design a brand-new master's programme focusing on microelectronics technologies. The new programme will be launched in the 2023/24 academic year, enabling students to cope with emerging technologies and industry needs. ASTRI's experts will co-teach three highly industry-relevant subjects: Integrated Circuits Design, Microelectronics Packaging and Reliability, and Machine Vision for Semiconductor Manufacturing and Inspections.

Hong Kong Science and Technology Parks Corporation (HKSTP)

PolyU has formed a partnership with HKSTP to facilitate entrepreneurship education and offer full-strength support to students and graduates to accelerate their growth at the start-up ideation and incubation stages. A joint GBA-focused entrepreneurship programme will be launched to combine the co-nurturing of innovative ideas with entrepreneurial training, coaching and mentorship to maximise the conversion of research into viable commercial success. A GBA Maker Express programme – a combination of the PolyU Maker Fund scheme with the HKSTP iDM-Square hardware acceleration platform – will also help Hong Kong hardware innovators turn their creative ideas into market-ready products.

MTR Corporation, MTR Academy
A three-year tripartite collaboration between the MTR Corporation, the MTR Academy and PolyU has been established. The collaboration will explore advanced and innovative railway technologies and facilitate smart railway asset and operations management, and intelligent maintenance. Collaboration areas include exploring smart solutions for monitoring and assessing the condition of railway assets, exploring the establishment of a joint laboratory for rail-technology applications, and research to improve the operating environment such as passenger flow management in stations.

PolyU has formed partnership with three strategic partners - **Everbright Limited, StartupHK Fund** and **Hai Robotics** - to further propel the University's "PolyVentures 2025" blueprint. The aim of this partnership is to translate research excellence into societal impact and thus contribute to the development of innovation and technology in the GBA. PolyU will collaborate closely with these strategic partners to provide comprehensive support to PolyU start-ups throughout their entrepreneurial journey, and equip them for long-term success, by further promoting the development of research and entrepreneurship in the GBA, and nurturing future research talent to address market needs.

Strategic partners participating in the PolyVentures InnoTech Showcase at PolyU's InnoTech Open Day

PolyU has also partnered with the **Federation of Hong Kong Industries (FHKI)** and the **Chinese Manufacturers' Association of Hong Kong (CMA)** to deepen university-industry collaboration. The partnerships will strengthen knowledge exchange and collaboration between the University and the two industry associations, share resources and networks to support the integration of start-ups and industry through start-up support schemes, co-invest in PolyU-related technology start-ups, and provide support to accelerate their growth. By combining the extensive experience of industry with the academic and scientific research excellence of PolyU, greater synergies will be generated, contributing to Hong Kong's re-industrialisation and development into an international innovation and technology hub.

7. CLOSING AND LOOKING FORWARD

PolyU aspires to be a world-class university with a strong emphasis on the societal impact of its education, research and knowledge transfer endeavours. Looking forward, the University will continue to review its strategies, policies and measures to advance research and knowledge transfer while addressing the needs of society and balancing the interests of key stakeholders.

Driven by the guiding principle that all PolyU IPs of practical value should leave campus to create societal impact, the University will further enhance entrepreneurship efforts to support more research-based and technology start-ups. In addition, the University will establish strategic partnership with industries and institutions to accelerate start-ups at their different development stages.

To celebrate PolyU's 85th anniversary this year, a book titled "PolyU's Key Innovations and Technologies" will be published to highlight the University's extraordinary journey in research, knowledge transfer and entrepreneurship. Guided by its motto "To learn and to apply for the benefit of mankind", PolyU will continue to pursue research excellence and excel in knowledge transfer, bringing innovative solutions to solve global problems and contributing to the innovation and technology development in the GBA and the Nation.

Dr Miranda LOU
Executive Vice President

Appendix 1: Performance Measure – KPIs & Additional Measures

(a) Key KT Performance Indicators

A summary of the key performance indicators for various KT areas are presented in the table below, with figures expressed in HK$'000:

Performance Indicators	2020/21 Actual	2021/22 Actual
Patenting & Licensing		
No. of patents granted [Note 1]	81	100
Accumulative no. of licenses granted	148	162
Income generated from IPR [Note 2]	$7,380	$11,135
Expenditure involved in generating income from IPR	$7,690	$9,056
Consultancy, Collaborative / Contract Research & Spin-off / Joint Ventures		
No. of collaborative research, income generated and total contract value [Note 3]	439 $250,022 $880,145	445 $194,517 $932,514
No. of contract research, income generated and total contract value [Note 4]	298 $82,822 $441,569	366 $204,438 $726,053
No. of consultancy projects and income generated [Note 5]	551 $63,298	540 $55,071
No. of economically active spin-off companies [Notes 6]	277	342
Other Knowledge Transfer / Dissemination Activities		
No. of equipment and facility service agreements and income	62 $1,596	74 $2,476
No. of student contact hours for business or CPD needs [Notes 7,8]	1,395,790	2,758,787
Income received from CPD courses [Note 8]	$923,818	1,099,368
No. of public lectures / symposiums / exhibitions and speeches to community	554	600
No. of performances and exhibitions of creative work by staff or students	35	37
No. of staff engaged as members of external advisory bodies	393	408

(b) Additional Performance Measurements

Performance Indicators	2020/21 Actual	2021/22 Actual
Innovation and Entrepreneurial Activities Enabling KT		
Accumulative no. of startups supported [Note 9]	380	452
Accumulative no. of academic involving startups [Note 10]	15	33
Accumulative no. of PolyU innovations / technologies / knowledge transferred through startups by students / alumni / staff [Note 11]	71	84
• No. of Entrepreneurship Fund applications [Note 12] • No. of students, alumni and staff involved [Note 13] • No. of new startups / entrepreneurial projects funded [Note 14]	326 1,001 56	353 675 73

Notes:

1. The reported figures include patent or patent applications co-owned by PolyU and external parties as well as patent or patent applications owned or co-owned by PolyU's subsidiaries. A detailed list of patents granted is presented in Appendix 3.
2. The reported figure includes license income generated from PolyU supported startups which licensed PolyU's IPs.
3. Collaborative research income reported is on cash-receipt basis from on-going projects in the reporting period. As some of the internally funded projects also involved third parties as collaborators for KT purpose, the number of those projects was counted here but not the income nor project value.
4. Contract research projects are those involving third parties from public, private and NGO sectors. The income reported is on cash-receipt basis from on-going projects in the reporting period.
5. The reported figure for FY2021/22 includes $13 million income from corporate and executive development training related consultancies (including those delivered by KTEO as mentioned in Note 9 below) and $42.1 million income from consultancy and advisory services, such as investigation, advisory on business, management, social, technical or policy related issue(s), as well as product, technology, materials or process enhancements.
6. The reported figure includes the number of all active startups that were either funded by PolyU funding programmes (including PolyU Micro Fund, China Entrepreneurship Fund, Tech Incubation Fund (TIF), Tech Launchpad Fund (TLF), Maker Fund, Good Seed Programme), or obtained license from PolyU to commercialise the University's IPs. Subsidiaries set up as operating vehicles for specific functional purposes, e.g. PTeC, Hotel ICON and PolyU Base in Shenzhen are not included.
7. The student contact hours are defined to be the number of enrolments multiplied by the number of contact/course hours.
8. The CPD courses include award-bearing and credit-bearing programmes (both in and outside Hong Kong) for learners already in work who are undertaking the course for purposes of professional development / upskilling / workforce development, in addition to short term non-credit-bearing training programmes. The reported figures for FY2020/21 and FY2021/22 include both full-time and part-time taught postgraduate programmes, part-time award bearing programmes offered by PolyU Proper, HKCC, SPEED and non-award bearing courses offered by PolyU Proper, SPEED and KTEO (as well as the income of corporate and executive development training delivered by KTEO via PTeC in the form of consultancy projects).
9. The reported figure includes all funded startups from Micro Fund, China Entrepreneurship Fund (CEF) Schemes, TIF, TLF, Maker Fund and Good Seed programmes.
10. The reported figure includes all academic-led startups with licenses from PolyU for commercializing the University's IPs.
11. The reported figure includes all PolyU supported startups founded by students, alumni or academic staff licensed PolyU's IPs and/or commercializing PolyU's innovations (e.g. students' final year projects).
12. The reported figure includes all applications under Micro Fund, China Entrepreneurship Fund (CEF) Schemes, TIF, TLF, Maker Fund and Good Seed schemes.
13. It also includes non-PolyU participants from the Good Seed Programme.
14. The reported figure includes all new startups under Micro Fund, China Entrepreneurship Fund (CEF) Schemes, TIF, TLF, Maker Fund and Good Seed schemes.

Appendix 2: The President's Awards for Outstanding Achievement in Knowledge Transfer 2021

No.	Impact Case	Principal Investigator(s)	Department
Four Individual Awards in Knowledge Transfer: Industry			
1	Nano-based Anti-erasing Ink for Printing on Plastic Surfaces	Prof. Pei Li	Department of Applied Biology and Chemical Technology (ABCT)
2	Advanced Topographic Mapping and Geomorphological Analysis Technologies Contributing to Landing Site Selection in Space Exploration Missions	Prof. Bo Wu	Department of Land Surveying and Geo-Informatics (LSGI)
3	3D Mapping Aided GNSS for Effective Positioning and Navigation in Urban Areas	Dr Li-Ta Hsu	Department of Aeronautical and Aviation Engineering (AAE)
4	Scolioscan: 3D Ultrasound Imaging System for Radiation-free Scoliosis Assessment	Ir Prof. Yongping Zheng	Department of Biomedical Engineering (BME)
Five Team Awards in Knowledge Transfer: Industry			
5	Nu-Torque™: Breakthrough in Yarn Manufacturing Technology for Better Textile Properties	• Prof. Tao Xiaoming, • Prof. Xu Bin-gang, • Dr Hua Tao	Institute of Textiles & Clothing
6	Smart Life-cycle Optimisation and Diagnostic Technologies for Buildings Energy Saving	Prof. Shengwei Wang, Prof. Xiao Fu and their research team	Department of Building Environment and Energy Engineering (BEEE)
7	Advanced Precision Engineering for Space Missions and Industrial Applications	Ir Prof. K. L. Yung and his research team	Department of Industrial and Systems Engineering (ISE)
8	Predictive Maintenance Railway Monitoring System Based on Optical Fibre Sensing	Prof. Tam Hwa-yaw and his research team	Department of Electrical Engineering (EE)
9	Myopic Defocus Technology for Myopia Control in Children	• Prof. Chi-ho To • Prof. Carly S.Y. Lam • Dr Dennis Tse	School of Optometry (SO)
One Team Award in Knowledge Transfer: Society			
10	Academic Research on Chinese Language Education with Impact on Knowledge Construction, Policy and Teaching Practice	• Prof. Chan Shui-duen • Prof. Zhu Xinhua	Department of Chinese and Bilingual Studies (CBS)

Appendix 3: List of Patents Granted in FY2021/22

No.	Patent Title	Filing Country/Region
1.	Crystal Control and Stability for High-Performance Perovskite Solar Cell	United States of America
2.	一種織物非水染色工藝方法	China
3.	用未提煉的低等原料環保式生產生物柴油的催化劑及方法	China
4.	Methods and Catalysts for Green Biodiesel Production from Unrefined Low Grade Feedstock	Hong Kong
5.	咔唑基磷配體、及其製備方法和應用	China
6.	從污染物產生能源	China
7.	Chiral Cyclen Compounds and Their Uses	United States of America
8.	多層結構的多纖維複合紗線	China
9.	用於對紗線施以假撚的設備和方法及用於生產紗線的設備	China
10.	Nanofiber Surfaces	United States of America
11.	一種基於銫鎢青銅的自清潔納米隔熱塗料及其製備方法	China
12.	一種基於類石墨烯電熱膜的光學元件模壓方法	China
13.	應用於精密玻璃光學顯微結構的微壓印設備和方法	China
14.	一種原位透射電子顯微鏡觀測納米顆粒生長的方法	China
15.	Electrodes for Batteries	United States of America
16.	Electrode for Battery and Fabrication Method Thereof	United States of America
17.	一種測量熱導率的方法及設備	China
18.	康復裝置、方法、電腦存儲介質和電子設備	China
19.	材料去除方法、控制系統、流體噴射拋光系統及存儲介質	China
20.	Electrostatically-charged Nanofiber Media and Fabrication Method Thereof	United States of America
21.	一體化加熱器及其溫度傳感方法	China
22.	自重定耗能支撐裝置	China
23.	Data Storage Using Peptides	United States of America
24.	Data Storage Using Peptides	United States of America
25.	Highly Sensitive Biomarker Biosensors Based on Organic Electrochemical Transistors	United States of America
26.	用於實現單核等效觀感的多核電腦系統的用戶端-伺服器架構	China
27.	基於點雲資料的平面提取方法、系統、裝置及存儲介質	China
28.	超聲裝置、超聲方法以及電腦可讀介質	China
29.	Peptides for Specific Inhibition of Jag1-Notch1 Pathway	United States of America
30.	一種平衡和步態的訓練方法、系統及終端	China
31.	一種用於織造針織梭織結合面料的方法	China
32.	超聲換能器及其製備方法	China
33.	一種用於批量化拋光工件的設備	China
34.	用於淡水和海洋環境的可移動除藻裝置	China

No.	Patent Title	Filing Country/Region
35.	一種無孔型防水透濕膜及其製備方法	China
36.	生物啟發式水下機器人	China
37.	Bio-Inspired Underwater Robot	United States of America
38.	定子動子軸向多段式旋轉直線電機和致動裝置及機器人	China
39.	管道機器人和系統	China
40.	一種基於三維地圖輔助 GNSS 的協同定位方法及系統、定位設備、存儲介質	China
41.	一種微壓印模具	China
42.	一種流體線射流拋光裝置及其應用方法	China
43.	一種斷紗檢測裝置、系統及其檢測方法	China
44.	Respirator with Adjustable Strap	Hong Kong
45.	對工件進行批量拋光的裝置和方法	China
46.	自動調節鞋墊剛度的鞋墊系統以及鞋	China
47.	Ring-Focus Spectacle Lens for Controlling Myopia Progression and Manufacturing Method Thereof	Hong Kong
48.	一種三維超聲成像方法及裝置	China
49.	喹啉鎓離子骨架結構有機染料化合物及其製備方法和應用	China
50.	形狀記憶複合骨釘及其製備、使用方法和應用	China
51.	法布裡-珀羅諧振腔光纖傳感器及其製造和氣體檢測方法	China
52.	仿生水回應形狀記憶聚氨基酸材料及其製備方法	China
53.	冬蟲夏草胞外多糖在益生菌保健食品和/或益生菌中藥中的應用	China
54.	冬蟲夏草胞外多糖在益生菌保健食品和/或益生菌中藥中的應用	China
55.	一種代理伺服器的檢測方法、檢測裝置及終端設備	China
56.	仿生水回應形狀記憶複合材料及其製備方法	China
57.	大氣環境中氣態污染物的非均相反應活性測量裝置和方法	China
58.	治療鼻咽癌的藥物組合物	China
59.	聚氨酯-脲纖維材料及其製備方法和應用	China
60.	一種傅裡葉鎖模雷射器	China
61.	滑坡提取方法、滑坡提取系統及終端	China
62.	一種基於介電電泳/電浸潤效應的微流晶片	China
63.	CTCF 轉錄因數抑制劑及其應用	China
64.	維生素 D 補充製劑及其應用	China
65.	一種提取道路邊緣資訊的方法及設備	China
66.	一種區域吸引力評估方法及設備	China
67.	深紫外微腔雷射器及其製備方法	China
68.	深紫外微腔雷射器	China
69.	道路層面細顆粒物反演方法、裝置、計算設備及存儲介質	China
70.	多葉型混凝土夾心板及其製備方法	China

No.	Patent Title	Filing Country/Region
71.	一種納米硒水溶膠及其製備方法與應用	China
72.	一種套管式內冷型膜式熱濕調控方法及其裝置	China
73.	新發傳染病發病風險預測方法、裝置、終端設備及介質	China
74.	一種遙感影像資料時空融合的方法、系統及設備	China
75.	一種分組跳模時域調製方法及傅裡葉鎖模雷射器	China
76.	一種僅含轉動關節的三自由度一平兩轉並聯機構	China
77.	一種內外副聯合驅動的三自由度一平兩轉並聯機構	China
78.	一種基於帶孔鋼板的混凝土複合構件及其製造方法	China
79.	一種基於帶孔鋼板的箱體結構及其製造方法	China
80.	一種基於破碎方法的地聚合物人工骨料的製備方法	China
81.	一種從點雲資料生成向量化道路模型的方法	China
82.	解決遮擋與錯誤映射的影像序列與點雲資料融合的方法	China
83.	一種利用三維空間資訊輔助全景相機拼接的方法	China
84.	一種利用矩形及扁率資訊的點雲配准方法及存儲介質	China
85.	一種移動預測方法、智慧終端機及存儲介質	China
86.	基於錨地與泊位自動識別演算法的港口擁堵監測方法	China
87.	一種融合 ESKF,g2o 和點雲匹配的緊耦合建圖方法	China
88.	基於社交媒體簽到預測目的地區域的方法、終端及存儲介質	China
89.	基於超構表面元件的光場差分三維成像	China
90.	一種建築物變化檢測方法、裝置、智慧終端機及存儲介質	China
91.	一種基於模組化鋼軌顆粒阻尼器的軌道交通減振降噪方法	China
92.	一種用於軌道交通減振降噪的模組化鋼軌顆粒阻尼器	China
93.	基於非線性離散譜信號的多符號聯合數位信號處理方法	China
94.	一種計步和確定行人的位置資訊的方法、系統及存儲介質	China
95.	一種靶向 Beclin1 的訂書肽、藥物組合物	China
96.	一種基於藍失諧連續光泵浦的微腔光頻梳產生裝置及方法	China
97.	一種槽式聚光集熱-光伏發電系統	China
98.	一種帶風幕屏的塔式吸熱器	China

Appendix 4: Details of Selected Impact Cases

Case 1: Evaluation Tools for Analysing the Effectiveness of Social Distancing Policies and International Border Control

1. Summary of the Impact

PolyU's team presents a leading research study to demonstrate that contact tracing can be an effective tool for controlling the spread of COVID-19 when borders reopen. With the COVID-19 vaccination widely implemented in most countries, propelled by the need to revive the tourism economy, there is a growing prospect for relieving the social distancing regulation and reopening borders in tourism-oriented countries and regions. This need incentivizes stakeholders to develop border control strategies that fully evaluate health risks if mandatory quarantines are lifted. In this research, we have employed a computational approach to investigate the contact tracing integrated policy in different border reopening scenarios in Hong Kong. By reconstructing the COVID-19 transmission from historical data, specific scenarios with joint effects of digital contact tracing and other concurrent measures (i.e, controlling arrival population and community non-pharmacological interventions) are applied to forecast the future development of the pandemic. The evidence suggests that digital contact tracing would be an effective countermeasure for reducing local virus spread, especially when it is applied along with a moderate level of vaccination coverage. Besides, implementing a daily quota on inbound travelers and restrictive community NPIs would further keep the local infection under control. This research provides scientific implications and prospective guidance for formulating plans to lift mandatory border control policies in preparing for global and local economic recovery.

2. Underpinning Research

An urgent need has emerged in Hong Kong and other regions to formulate a sustainable strategy for reopening international borders by relieving the quarantine requirements while simultaneously applying digital contact tracing. In this regard, PolyU research team proposes a framework to integrate the importation risk induced by potential virus carriers into a mechanistic epidemic model in a case study of Hong Kong. Two important research questions ought to be addressed: (1) To what extent can digital contact tracing help contain the local infection compared to scenarios without contact tracing? (2) To what extent can the containment measures be improved, such as combining digital contact tracing with the inbound quota and community non-pharmacological interventions (NPI)?

In response to the imported COVID-19 cases, the government has fully implemented a mandatory quarantine scheme on December 25, 2020, for all inbound visitors, aiming to cut off the contact between infectious cases and local communities. Researchers collect and analyze the daily reported COVID-19 cases provided by the Centre for Health Protection (CHP) of the Department of Health in Hong Kong. Imported cases are not attributed to the local spread because of the screening and mandatory quarantines imposed on all incoming travelers since December 2020. To estimate the local spread of COVID-19 in Hong Kong, local cases and cases epidemiologically linked to local cases are included from December 25, 2020.

A classic stochastic SEIR (Susceptible - Exposed - Infectious – Recovered) model is proposed to estimate the course of the epidemic development by fitting the observed cumulative daily reported cases in Hong Kong. Hypothetical scenarios are proposed to understand whether digital contact tracing can help to contain the importation risks when only a proportion of local residents are vaccinated. The model imposes digital contact tracing on all inbound travelers during their entire stay in Hong Kong. Specifically, susceptible population (S) who closely contact with infectious travelers (I) will be immediately quarantined or isolated, becoming removed population (R) instead of being exposed or infectious population existing in the community. The schematic to explain this rationale is shown in Figure 1 and Figure 2. If any user is confirmed positive for COVID-19, they can share their record with all other users at their own discretion (or through a public health department that is acting as a central coordinator on the use of the mobile app). The app on other users' handsets will then automatically compare the individual users' record against the record received. If the record overlaps with that of the confirmed case, individual users will be immediately alerted to take appropriate actions. Although digital contact tracing can help contain the local infection, its implementation cannot ensure a promising health outcome in the most realistic or the worst-case scenario (30% vaccination coverage). Considering that only a small susceptible population is vaccinated, in addition to contact tracing, it is imperative to estimate the joint effects of

controlling arrival population and implementing community NPIs. In this regard, a set of scenarios combining the daily quota and the community NPIs are proposed.

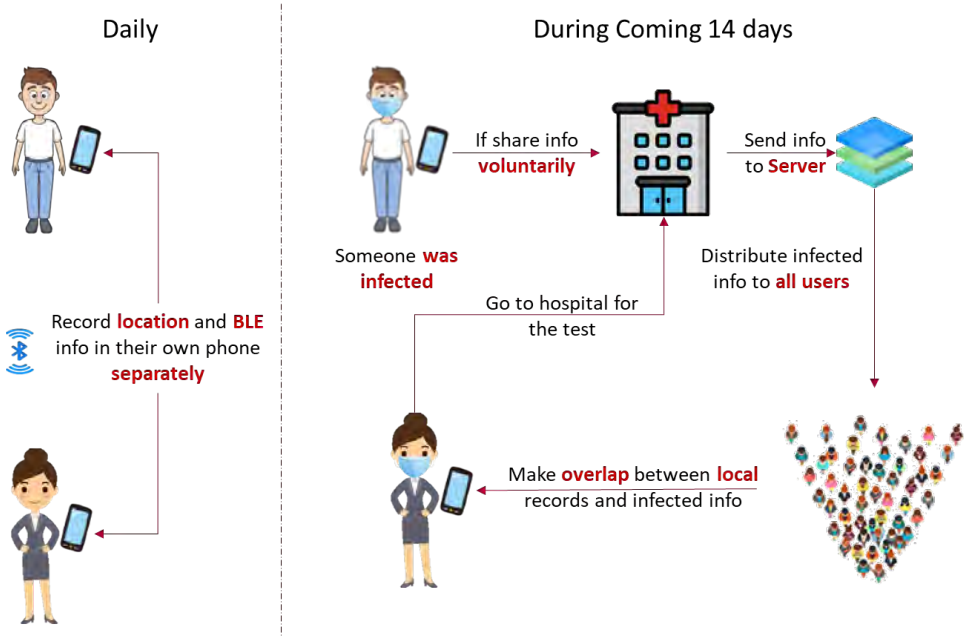


Figure 1. the real-world working principle of contact tracing app developed by Prof. CHEN and his research team.

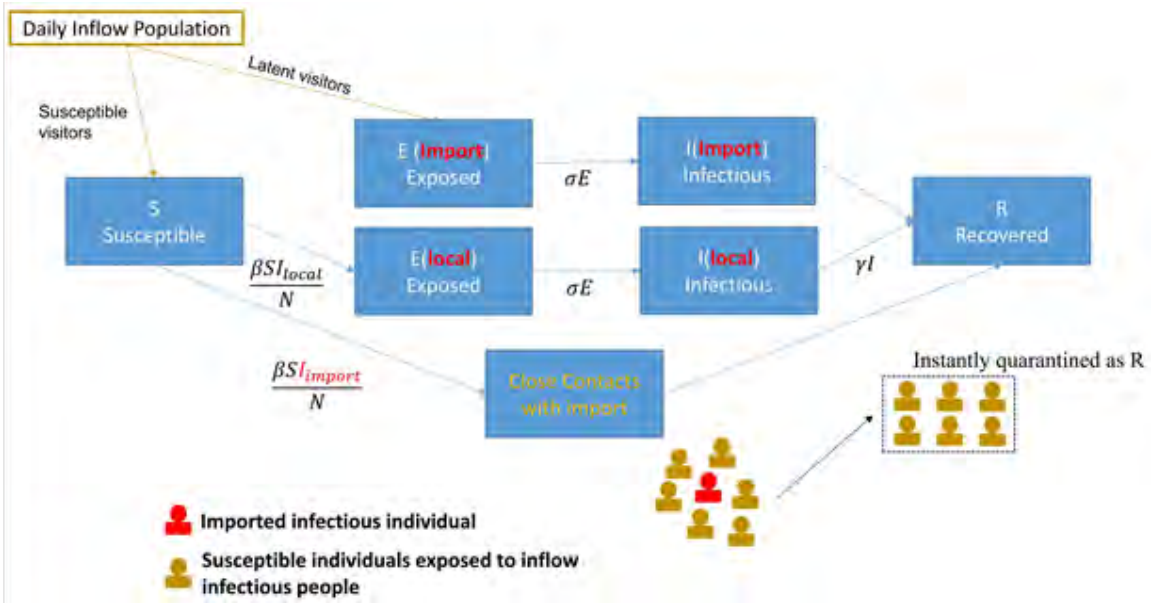


Figure 2. the schematic to explain t how digital contact tracing help to contain the importation risks.

3. References to Research

Publication:

Yu, Z., Zhu, X., Liu, X., Wei, T., Yuan, H. Y., Xu, Y., ... & **Chen, W.** (2021). Reopening international borders without quarantine: contact tracing integrated policy against COVID-19. *International journal of environmental research and public health*, *18*(14), 7494.

Grants: Logistics and Supply Chain MultiTech R&D Centre Limited, HK$2,353,000.
Evaluation Tools for Analysis for the Effectiveness of Social Distance Policies and International Border Control for the Spread of COVID-19 Pandemic [P21-0143]

4. Impact and Benefits

This economic downturn was caused by the global spread of the coronavirus disease 2019 (COVID-19), whereas many countries closed their borders to contain the virus spread resulted from international travel and trade. There is a growing prospect for relieving the social distancing regulation and reopening borders in tourism-oriented countries and regions. Prof. Chen's research team have played an essential role in evaluating and containing the importation risk of COVID-19 in Hong Kong. A simulation study is proposed to evaluate the effectiveness of digital contact tracing under different vaccination scenarios without mandatory quarantines.

Two main policy recommendations are drawn from this research. First, digital contact tracing would be an effective countermeasure for reducing local virus spread, especially when it is applied along with a moderate level of vaccination coverage. Contact tracing is an influential factor in controlling the spread because all the necessary pandemic control measures would not be promptly carried out without effective tracing against confirmed cases and identifying their close contacts. Explicitly, built on an epidemic model with 50% vaccination coverage, the results suggest that scenarios with digital contact tracing can reduce the infectious population by 84.7% compared to those without contact tracing (Figure 3). Further, implementing a daily quota on inbound travelers and restrictive community NPIs would further keep the local infection under control. Combined together, digital contact tracing integrated policies are illustrated and suggested as regards to lifting mandatory quarantine rules in preparing for the global economic recovery. A practical insight into sustainable border-reopening policies is provided by this study and can be considered by Hong Kong and other regions

Given the simulation evidence, the research team has meanwhile introduced Hong Kong's first mobile app prototype with a contact tracing feature, exclusively designed for use by inbound travelers, that would help fight the pandemic at the press conference on 1st September (Figure 4). Utilizing the Global Navigation Satellite System, Bluetooth Low Energy and Data Analysis Technology, the mobile app is designed not only for users to record individual locations they have visited but more importantly to help users identify whether they have had close contact with those who have tested positive for COVID-19 within the last 14 days (Figure 5). Regarding the privacy concerns, Prof. Chen emphasize that all the information recorded by the mobile app is saved in the users' own handsets only. No personal data is required when users download or use the app, and only anonymous data will be shared with other users.

The app will also provide convenience for users to access the COVID-19 pandemic information released by the Government. Ultimately, this research offers scientific evidence and prospective guidance for developing and instituting plans to lift mandatory border control policies in preparing for the global economic recovery.

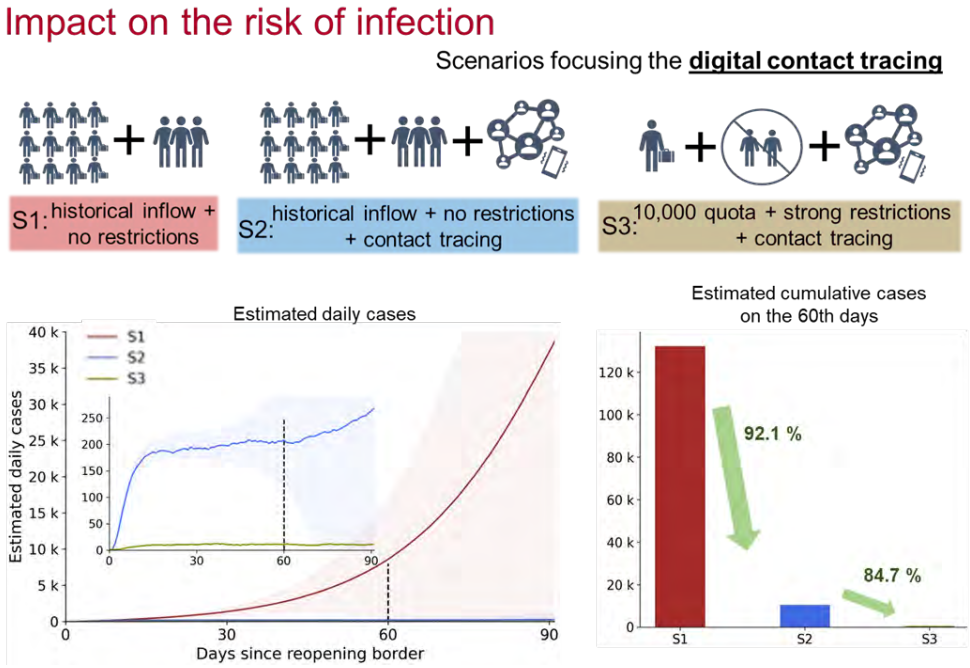


Figure 3. the analytics to demonstrate that contact tracing is key to effectively controlling the spread of the virus when borders reopen.

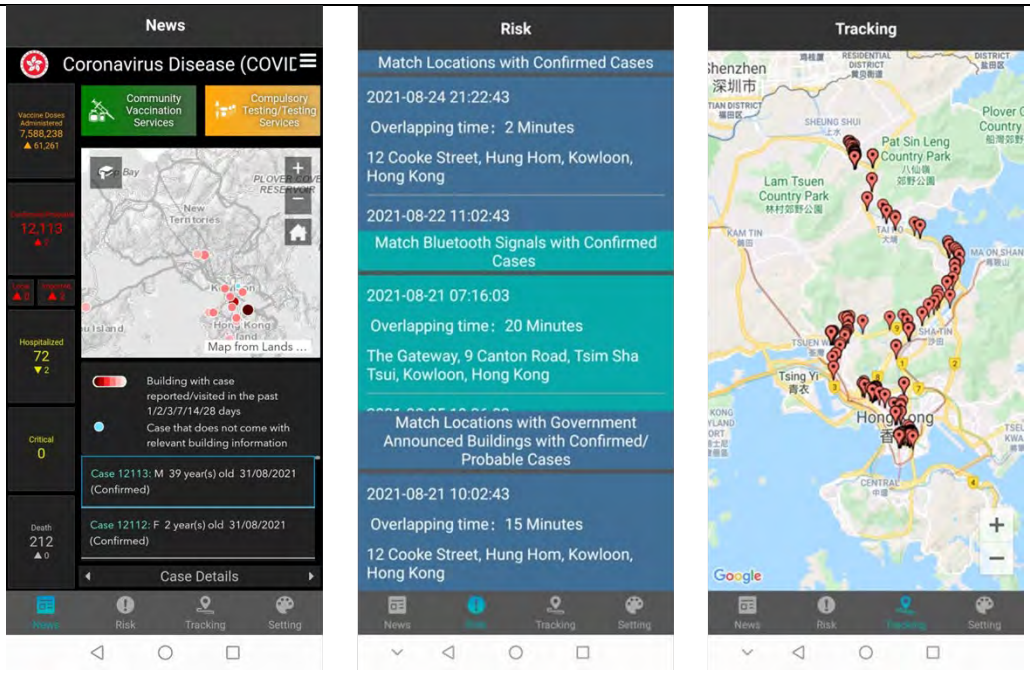


Figure 4. Prof. Chen Wu (middle) Prof. Charles Wong (left), and Dr. Zhu Xiaolin (right) present the prototype contact tracing app (Safety Guarder) at the press conference.

Figure 5. the interface illustration of Safety Guarder mobile app developed by Prof. Chen Wu and his research team.

5. References to the Corroboration of Impact and Benefits

a. 理大研具追蹤功能應用程式 通關後及早追蹤入境旅客 [TVB 無綫電視, link]
b. 理大研究指通關後如及早追蹤入境旅客可大幅降低感染率 [RTHK 香港電台, link]
c. PolyU researchers developed Bluetooth tracing app [RTHK 香港電台, link]
d. PolyU sets up new Covid-tracking app [The Standard 英文虎報, link]
e. 新冠肺炎｜理大研自動追蹤抗疫程式　用戶自願呈數據保私隱 [Mingpao 明報, link]
f. 新冠肺炎｜理大研發手機程式 開關後追蹤入境者 確診可減八成半 [HK01 香港 01, link]

Figure 6. Extensive media reports regarding PolyU's efforts to fight the COVID-19 pandemic.

Case 2: Portable Nucleic Acid Testing Device Enables Fast and Accurate Results On-site

1. Summary of the Impact

Since the first case of coronavirus disease 2019 (COVID-19) was reported in late December 2019 in Mainland China, COVID-19 has now become a global pandemic. The causative pathogen severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has been spread globally. As of late July 2022, there have been more than 574 million people having been infected by SARS-CoV-2 globally and more than 1.3 million people infected in Hong Kong. The total death tolls are more than 6.3 million worldwide and more than 9,000 in Hong Kong. The pandemic has already made traumatic damages to human health, healthcare systems, supply chains and economies that have never been seen before in human history.

Strategies to reduce the spread of the virus include testing, contact tracing, isolation, treatment and vaccination. Testing for the presence of the virus SARS-CoV-2 in human specimens has always been the first and most important step – testing, testing and testing. The globally recognised gold standard of detecting SARS-CoV-2 is based on an assay known as reverse transcription polymerase chain reaction (RT-PCR), which amplifies and detects the viral genome. RT-PCR is very sensitive and reliable regardless of whether the subjects are symptomatic or asymptomatic. Since RT-PCR is usually performed in medical laboratories rather than on-site, the testing results are available only in several hours (even up to 12–24 hours).

On the other hand, rapid antigen test (RAT) detects a particular viral protein on the virus (SARS-CoV-2) and can be performed by any persons at home or any convenient location. RAT can give testing result within 15–20 minutes and hence is very convenient. However, RAT can produce both false negatives and false positives, which can produce severe consequences in both settings of hospitals and communities. Therefore, follow-up testing with RT-PCR is usually required to confirm the infection.

The interdisciplinary research team has used an amplification method known as reverse transcription-loop-mediated isothermal amplification (RT-LAMP) and visualised the reaction with *modified gold nanoparticles* invented by the research team. The assay is called **Gold-RT-LAMP**. The assay can be completed within 45 minutes and requires only a simple portable testing device with a heat block maintained at 65°C and a simple optical system, rather than an expensive, sophisticated instrument required for RT-PCR.

In a nutshell, Gold-RT-LAMP has the same sensitivity and specificity as the gold standard RT-PCR for detecting SARS-CoV-2, but can be performed on-site with a simple portable device. Moreover, Gold-RT-LAMP can produce accurate results within 45 minutes. ***Gold-RT-LAMP has the advantages of both RT-PCR and RAT, but circumvents the disadvantages of both RT-PCR and RAT.*** Therefore, Gold-RT-LAMP fills the gap left by RT-PCR and RAT.

In brief, the research team has developed a simple portable testing device for carrying out the new assay Gold-RT-LAMP for detecting SARS-CoV-2 in decentralised settings. There are both medical and non-medical applications. *Medical applications* refers to testing of human subjects in decentralised settings requiring sensitive and accurate results, such as emergency departments of hospitals, clinics, quarantine centres, airports, cross-border customs and different types of facilities that require rapid testing of people before entering. Medical applications can also include testing of animals like pets. On the other hand, *non-medical applications* include on-site environmental testing to ensure non-infectious environment in public places (clinics, malls, fitness centres, etc.), food testing for safe consumption, and testing of consumer sterilisation products to provide scientific data for their effectiveness.

In addition, ***the Gold-RT-LAMP assay can also be used to detect any microorganisms of choice (including any viruses and bacteria).*** This can easily be achieved by re-designing the reaction component primers and amplifying the viral or bacterial genes (either DNA or RNA) accordingly. Again, this extension can be applied in both medical and non-medical settings.

2. Underpinning Research

In the past decade, the interdisciplinary research team has developed related technologies through several sequential stages.

The first stage is the development of closed-tube colourimetric polymerase chain reaction (PCR) based on gold nanoparticles that have been conjugated with silica-modified oligonucleotides [1,2]. The PCR results can be read by naked eyes in this system. The breakthrough is the development of a one-step *closed-tube* format for visible PCR (**Figure 1**), which has not been achieved until this report [1,2].

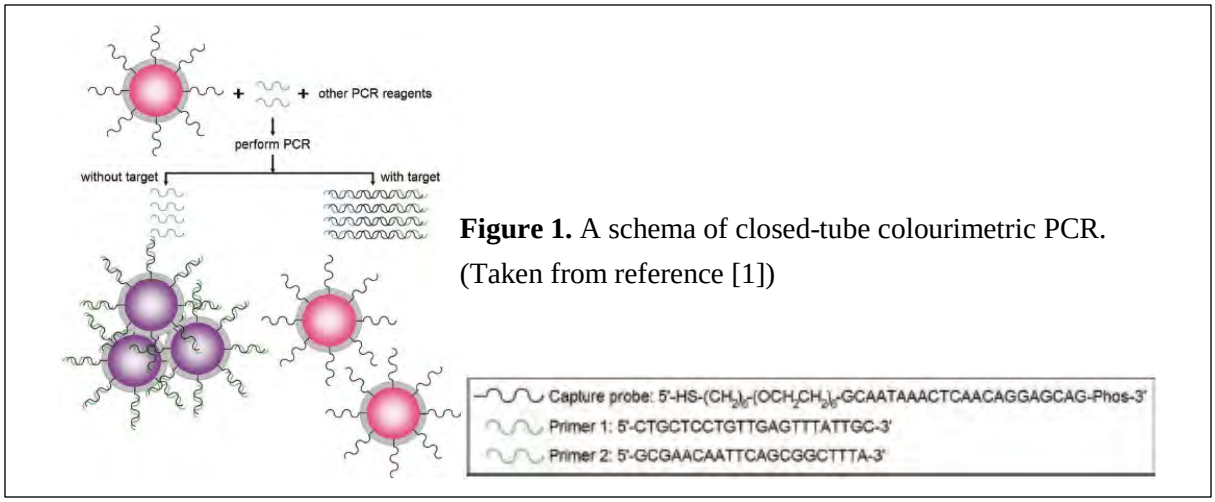


Figure 1. A schema of closed-tube colourimetric PCR. (Taken from reference [1])

The second stage is the development of ultrasensitive, closed-tube LAMP assay based on gold nanoparticles (AuNPs) modified by 11-mercaptoundecanoic acid (MUA) (MUA-AuNPs) (**Figure 2**) [3]. This new system enjoys all the advantages of high sensitivity and specificity, simple temperature control (fixed at 65°C and no need for thermal cycling), visual readout of results, closed-tube format and hence avoidance of carry-over contamination, low cost and rapid analysis (~1 hour). The assay is also sensitive down to 200 copies of DNA per reaction – the most sensitive among all AuNP-based visible DNA detection techniques reported at that time [3].

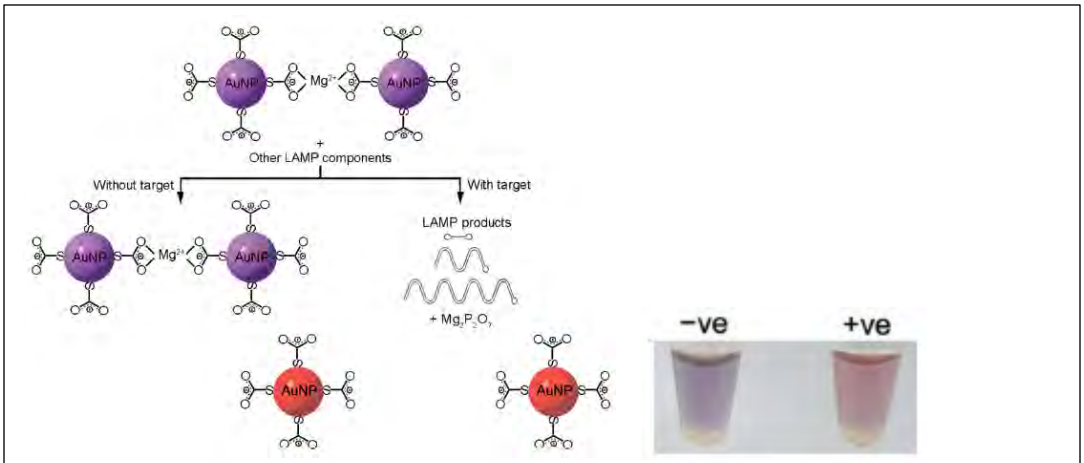


Figure 2. A schema of closed-tube colourimetric LAMP assay based on MUA-AuNPs. (Taken from reference [3])

The third stage is the development of AuNPs modified by two chemicals, namely polyethylene glycol (PEG) and MUA (PEG/MUA-AuNPs). PEG/MUA-AuNPs can be co-precipitated with magnesium pyrophosphate ($Mg_2P_2O_7$), which is a by-product released during the LAMP reaction, to form red precipitate [4]. In other words, the reaction remains unchanged as a red solution for a negative sample (without target DNA) while a red precipitate is observed in the reaction for a positive sample (with the target nucleic acid sequence) (**Figure 3**). The breakthrough is the precipitation-based readout of amplification reaction that allows real-time monitoring of the reaction and point-of-care testing of nucleic acid [4]. In addition, **Figure 4** shows the first homemade prototype of a portable testing device for real-time monitoring of LAMP reaction [4].

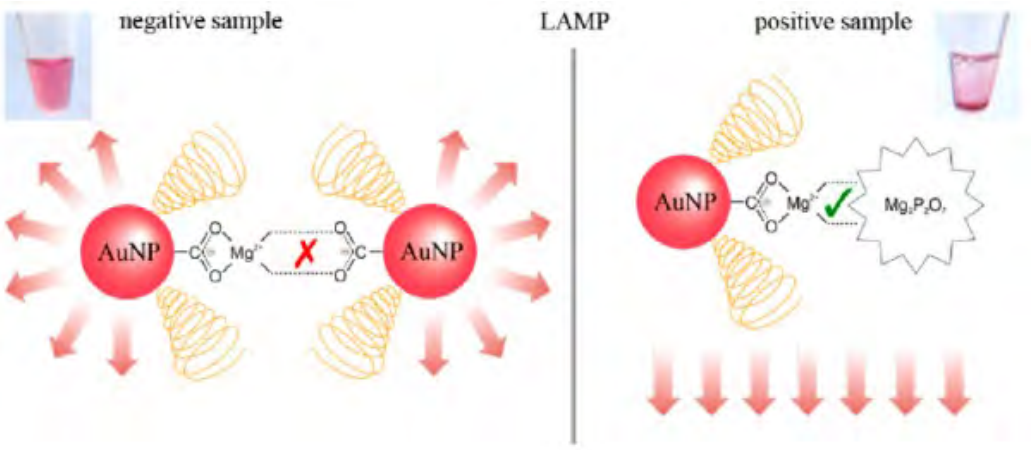


Figure 3. A schema of LAMP assay visualised by co-precipitation of PEG/MUA-AuNPs with $Mg_2P_2O_7$. (Taken from reference [4])

The fourth stage is the application of PEG/MUA AuNPs with optimised reaction conditions for the detection of SARS-CoV-2 with detection limit down to 4 copies of SARS-CoV-2 genomes per reaction. This is the Gold-RT-LAMP assay. At the same time, a new portable device (**Figure 4**) with 6 reaction wells was designed and produced by PolyU's Industrial Centre. Preliminary study with purified nucleic acid samples collected from patients, the results obtained by Gold-RT-LAMP assay shows 100% concordance with the gold standard method of RT-PCR. The research team will also use the new assay to detect small viral RNA species [5] that may be used to predict the severity of the disease in infected individuals to facilitate triage of patients with severe disease for hospitalisation and patients with mild disease for quarantine in non-hospital facilities.

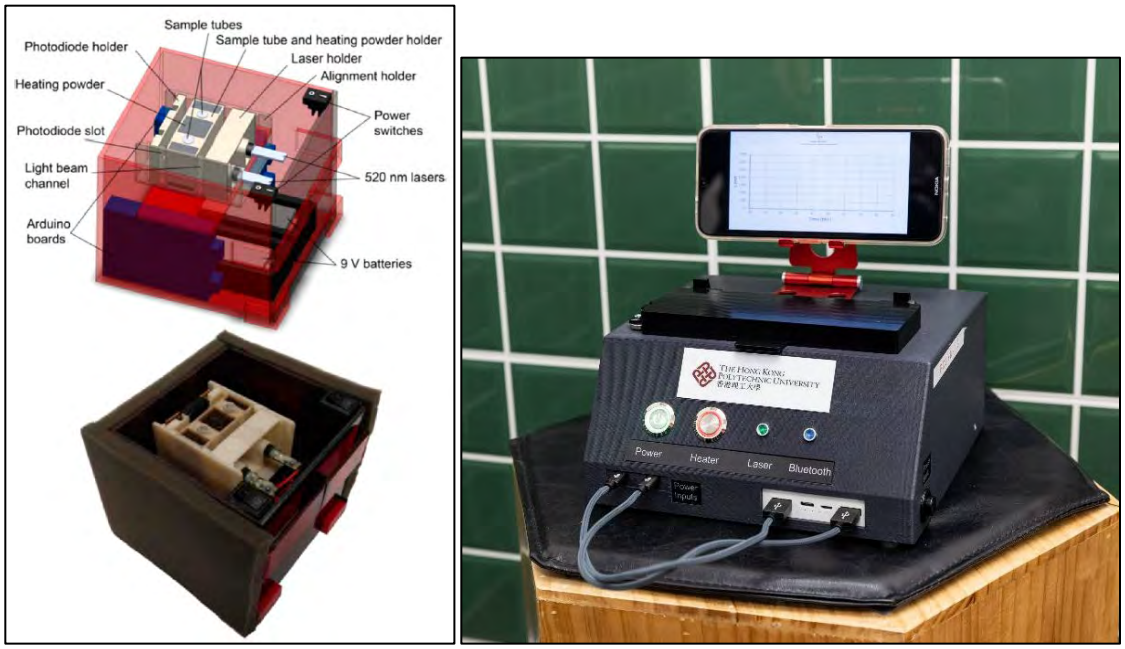


Figure 4. Simple portable testing devices. The first prototype (left) was made by an undergraduate student while the latest testing device (right) was designed and built by PolyU's Industrial Centre.

The research team has also utilised quantum dots (fluorescent inorganic semiconductor nanocrystals) for development of new molecular assays (**Figure 5**) with sensitivity down to 1 copy of DNA or RNA per reaction [6].

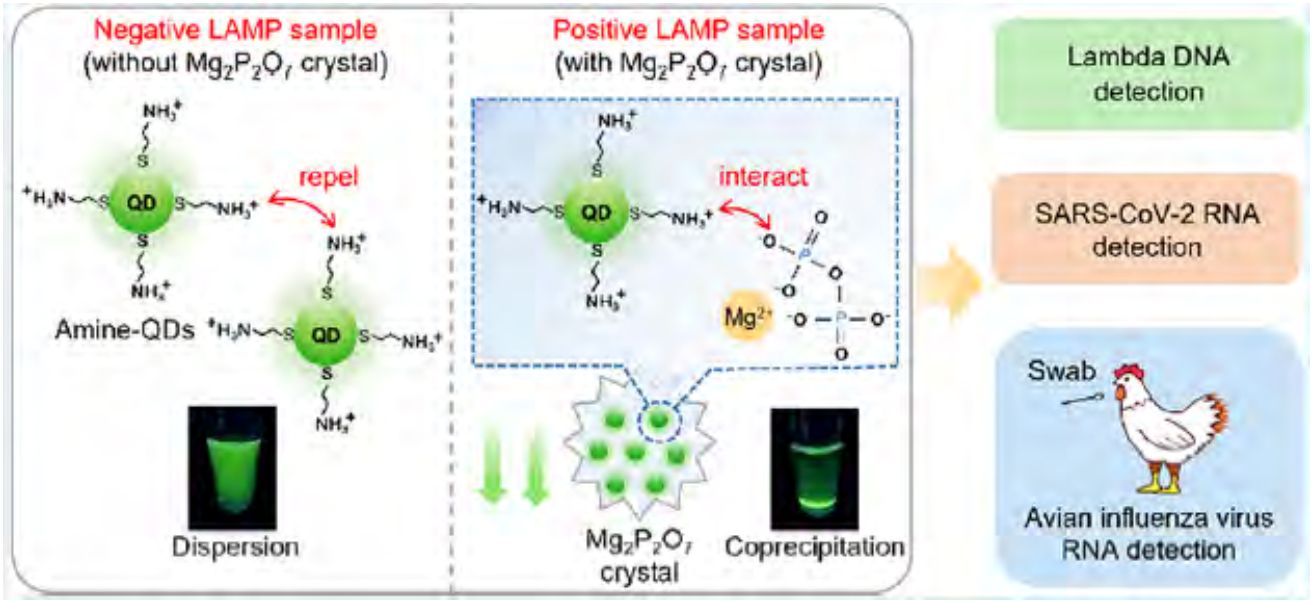


Figure 5. A schema of LAMP assay utilizing amino-functionalised quantum dots for fluorescence readout. (Taken from reference [6])

3. References to Research

a. Related research grants:

2008 **Competitive Earmarked Research Grant (CERG)** **HK$710,917**
Colourimetric polymerase chain reaction
Thomas Lee (PI), SP Yip

2013 **General Research Fund (GRF)** **HK$1,001,800**
Facile surface modification of gold nanoparticles for closed-tube colorimetric detection of isothermal DNA amplification
Thomas Lee (PI), SP Yip

2017 **PolyU Internal Grant** **HK$105,000**
A new sensing mechanism for real-time monitoring of isothermal DNA/RNA amplification based on magnesium pyrophosphate-triggered precipitation of nanomaterials
Thomas Lee (PI), SP Yip

2020 **Health and Medical Research Fund (HMRF)** **HK$2,716,484**
A low-cost handheld device for decentralised detection of SARS-CoV-2 and host response in COVID-19 patients: Development and evaluation
SP Yip (PI), Thomas Lee, Gilman Siu, CL Huang, Jimmy Lam, Kitty Fung & KK Jong

2021 **Inter-Faculty Collaboration Scheme for FH, FHSS & FENG (IFC3)** **HK$498,584**
Decentralized COVID-19 testing using fluorescent nanoprobes
Thomas Lee (PI), SP Yip, Gilman Siu, CL Huang

2022 PolyU Internal Grant HK$1,500,000
Evaluation of the performance of a RT-LAMP assay for rapid diagnosis of SARS-CoV-2 in the Emergency Department of Queen Mary Hospital
SP Yip (PI), Thomas Lee, Gilman Siu, CL Huang, Rex Lam, Timothy Rainer, Matthew Tsui, TC Tsang, Vincent Cheng, CS Lau

b. Publications (including references cited above)

(* refers to corresponding or co-corresponding author)

[1] Wong JK, **Yip SP**, **Lee TM***. Silica-modified oligonucleotide-gold nanoparticle conjugate enables closed-tube colorimetric polymerase chain reaction. *Small* 2012; **8**: 214-219. (2012 IF = 7.823)

[2] Wong JK, **Yip SP**, **Lee TM***. Ultra-stable oligonucleotide–gold and –silver nanoparticle conjugates prepared by a facile silica reinforcement method. *Nano Res* 2012; **5**: 585–94. (2012 IF = 7.392)

[3] Wong JK, **Yip SP**, **Lee TM***. Ultrasensitive and closed-tube colorimetric loop-mediated isothermal amplification assay using carboxyl-modified gold nanoparticles. *Small* 2014; **10**: 1495-9. (2014 IF = 8.368)

[4] Qin A, Fu LT, Wong JK, Chau LY, **Yip SP**, **Lee TM***. Precipitation of PEG/carboxyl-modified gold nanoparticles with magnesium pyrophosphate: A new platform for real-time monitoring of loop-mediated isothermal amplification. *ACS Appl Mater Interfaces* 2017; **9**: 10472-80. (2017 IF = 8.097)

[5] Meng F, Siu GK, Mok BW, Sun J, Fung KS, Lam JY, Wong NK, Gedefaw L, Luo S, Lee TM, **Yip SP***, **Huang CL***. Viral microRNAs encoded by nucleocapsid gene of SARS-CoV-2 are detected during infection, and targeting metabolic pathways in host cells. *Cells* 2021; **10**: 1762. (2021 IF = 7.666)

[6] Wang S, Qin A, Chau LY, Fok EW, Choy MY, Brackman CJ, **Siu GK**, **Huang CL**, **Yip SP***, **Lee TM***. Amine-functionalized quantum dots as a universal fluorescent nanoprobe for a one-step loop-mediated isothermal amplification assay with single-copy sensitivity. *ACS Appl Mater Interfaces* 2022 Jul 27. doi: 10.1021/acsami.2c02508. Epub ahead of print. (2021 IF = 10.383)

[7] Gedefaw L, Ullah S, Leung PH, Cai Y, **Yip SP***, **Huang CL***. Inflammasome activation-induced hypercoagulopathy: Impact on cardiovascular dysfunction triggered in COVID-19 patients. *Cells* 2021; **10**: 916. (2021 IF = 7.666)

[8] Gedefaw L, Ullah S, Lee TM, **Yip SP***, **Huang CL***. Targeting inflammasome activation in COVID-19: Delivery of RNA interference-based therapeutic molecules. *Biomedicines* 2021; **9**: 1823. (2021 IF = 4.757)

4. Impact and Benefits

(a) A portable testing device and a rapid, sensitive molecular assay for detecting SARS-CoV-2

The portable testing device is featured with a heat block that can be maintained at 65°C for RT-LAMP reaction. The light signal is detected and the reaction monitored in real-time by transmitting the signals to a smartphone via Bluetooth. As such, the testing device is simple, portable and low-cost. RT-LAMP has been used to detect SARS-CoV-2 by many other research teams, but its sensitivity reported to be over 100 copies per reaction (therefore, much less sensitive than RT-PCR). With modified gold nanoparticles as a visualisation agent, Gold-RT-LAMP has a sensitivity matching that of RT-PCR. Therefore, Gold-RT-LAMP assay possesses the advantages of both RT-PCR (high sensitivity) and RAT (rapid assay) and circumvents the disadvantages of RT-PCR (expensive, sophisticated instrument) and RAT (moderate sensitivity and specificity). Together with a portable testing device, Gold-RT-LAMP provides a low-cost platform for point-of-care testing for the detection of SARS-CoV-2 with wide application in both medical and non-medical settings.

(b) Gold-RT-LAMP for detecting any microorganisms of choice

Gold-RT-LAMP can easily be adopted to detect the nucleic acid of any microorganisms of choice (any virus or bacteria) by re-designing the primers for the assay.

(c) Evaluation of Gold-RT-LAMP assay in the Emergency Department of Queen Mary Hospital

A press conference was organised in mid-April 2022, announcing the excellent performance of the Gold-RT-LAMP assay. This has attracted the attention of many potential users and investors. In addition, this has also attracted the attention of Prof. LAU Chak Sing (HKU), who invited the research team to evaluate the real-life performance of the assay on-site in the Accident and Emergency Department of Queen Mary Hospital. This is the first time that a molecular assay has been evaluated on-site to identify patients infected with SARS-CoV-2 in an emergency department of a hospital. This clinical study has just been completed with exciting results.

(d) Formation of an academic-led start-up for commercialization of the invention

The research team has just formed a new start-up company to commercialise the invention. The start-up will deal with the commercial side of the translational study. The start-up will gather funding for its development and operation from private investors, PolyU (Enterprise Investment Fund), Hong Kong Science and Technology Park (Incu-Bio), Innovation and Technology Commission (TISSSU).

5. References to the Corroboration of Impact and Benefits

Press release (12 April 2022):
English - https://polyu.me/3jwc4rT; Chinese - https://polyu.me/3utQwm5

Online coverage:
1. TVB - https://polyu.me/3jy3Orz
2. Now TV - https://polyu.me/3E66VjV
3. i-Cable - https://polyu.me/3O82tFN
4. RTHK - https://polyu.me/3JzztUb (English); https://polyu.me/3JxMc9G (Chinese)
5. RTHK (COVID Update) - https://polyu.me/3xkPKtp (20:43 - 29:59)
6. Commercial Radio - https://polyu.me/3LScHbs
7. SCMP - https://polyu.me/3E9aLJ5
8. The Standard - https://polyu.me/3jA7qZY
9. IntellAsia - https://polyu.me/3uAK399
10. Mirage News - https://polyu.me/37daUiz
11. Oriental Daily News - https://polyu.me/3xodBIJ
12. Sing Tao Daily - https://polyu.me/37EEiy6
13. Ming Pao Daily News - https://polyu.me/3jvur02
14. Hong Kong Economic Times - https://polyu.me/364wnd5
15. Hong Kong Economic Journal - https://polyu.me/3uGN4Vz
16. Headline Daily - https://polyu.me/367yk8D
17. am730 - https://polyu.me/3rlot6k
18. Sky Post - https://polyu.me/3jxGDO3
19. Ta Kung Pao - https://polyu.me/3JD4ypI
20. Wen Wei Po - https://polyu.me/3uAKf8n
21. Hong Kong Commercial Daily - https://polyu.me/3xk55KU
22. HK01 - https://polyu.me/3xl51dH
23. ezone - https://polyu.me/3LV6TOz
24. Bastille Post - https://polyu.me/3jwmA2C
25. Dot News - https://polyu.me/3riIYAM
26. Orange News - https://polyu.me/3KBhdLo
27. People's Daily Overseas Edition - https://polyu.me/3E5IOSu
28. Hong Kong China News Agency - https://polyu.me/3ro4WCu
29. China News - https://polyu.me/3KBLvh9
30. Science Net - https://polyu.me/3jvzrSH

Interviews
CRHK 1 在晴朗的一天出發
Host: 陳志雲，陳聰，楊樂笙
Interview time: 8:20-8:30am (20220413)

http://file.crhk.com.hk/pnd/files/temp/yILEAjfwLYuELnixmFVt/0413 葉社平教授.mp3

中新社訪問 （20220414）
https://m.chinanews.com/wap/detail/chs/sp/9728977.shtml

南方都市報 (Southern Metropolis Daily; 20220415)
https://ipaper.oeeee.com/ipaper/G/html/2022-04/15/node_2666.htm#edition=EA08
https://polyu.me/3jOwOLA

RTHK (防疫速遞)
https://youtu.be/CdHLK55uGbM
https://polyu.me/3vpNXRf

Bioworld
https://www.bioworld.com/articles/517986-hong-kong-researchers-develop-portable-covid-19-testing-device (subscription required)

Case 3: Development of a Modular Rail Damper Based on Particle Damping Technology for Controlling Rail Corrugation Growth and Broadband Rolling Noise in Railways

1. Summary of the Impact

CNERC-Rail has made good progress in developing a new type of rail particle dampers for rail noise and vibration control and rail corrugation suppression. A modular rail particle damper based on the particle damping mechanism and a machine learning algorithm is devised in solving the rail vibration and associated traffic noise in urban rail transit systems. As a vibration reduction and noise suppression approach, this technology can effectively reduce the operating frequency of periodic maintenance of rails, improve operation and maintenance efficiency, and solve the problem of environmental noise pollution caused by rail transit operations. This technology has been or is being applied to the operational lines of Hangzhou Metro, Shenzhen Metro and Hong Kong MTR.

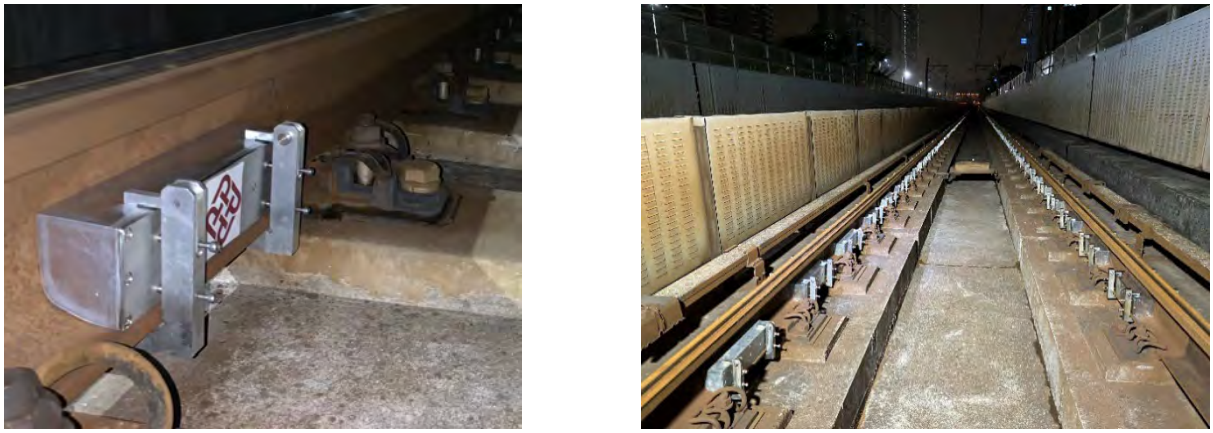


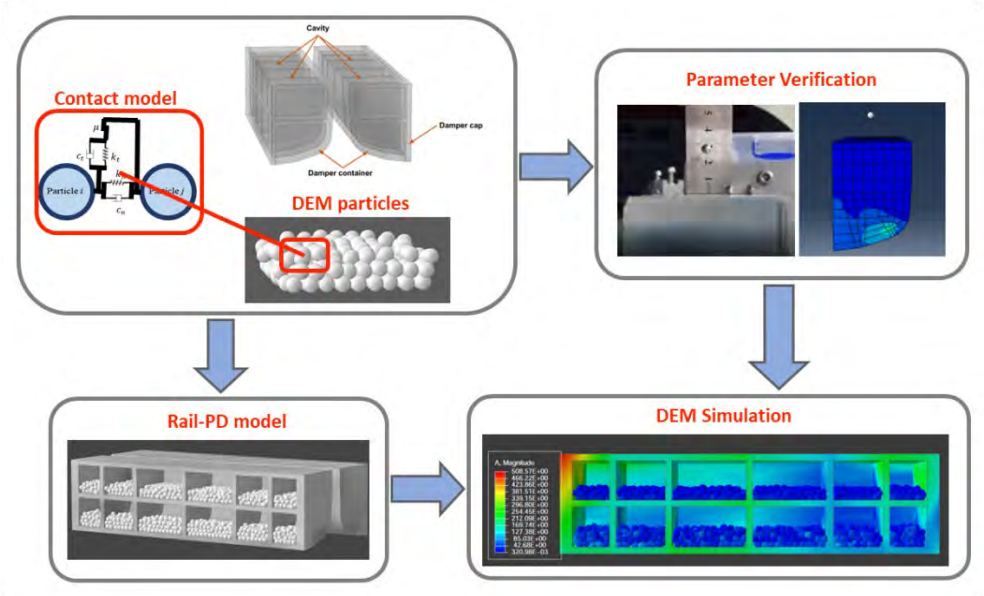
Figure 1: Configurations of Modular Rail Particle Dampers

2. Underpinning Research

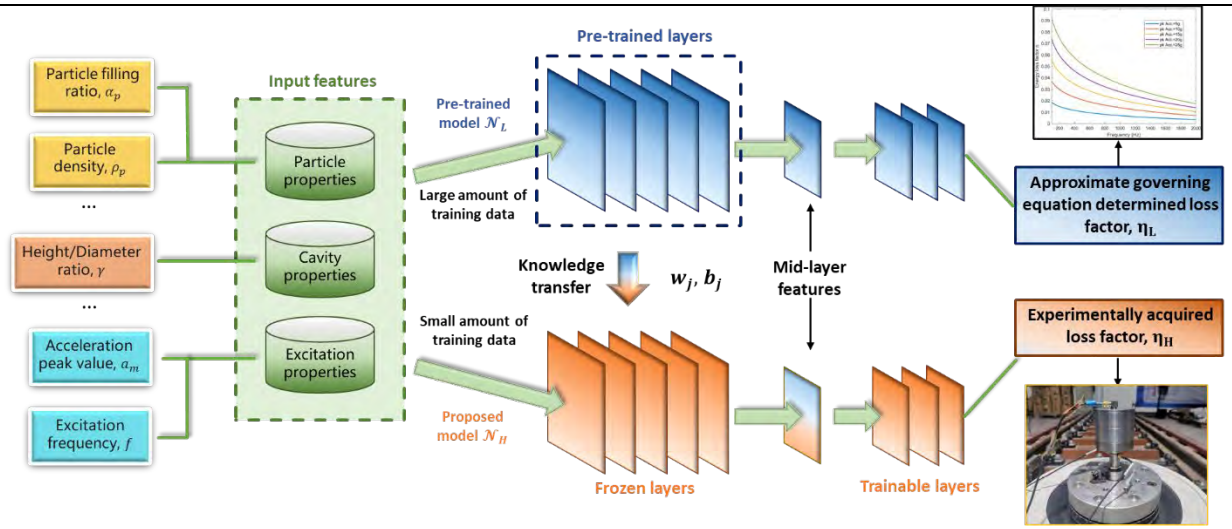
Rolling noise generated by strong wheel-rail interactions is a global concern and reducing noise and vibration in operating railway systems is critical to ensuring safety and maintainability and protecting human health. CNERC-Rail has designed and developed a new type of rail particle damper as a noise and vibration control device for railways. Its performance was evaluated by conducting comprehensive experiments and numerical simulations.

To take advantage of particle damping technology in the railway industry, a modular design concept in conjunction with the particle damping approach and an advanced machine learning algorithm is adopted to develop a novel Modular Rail Particle Damper (MRPD). This design concept which cannot be found in any other rail dampers, will be adopted to tune the rail damper for multiple target frequency bands based on actual rail track dynamic characterizations. In this way, the rail vibration will be dissipated effectively, resulting in rail corrugation growth control and rolling noise reduction via particle damping effect. The particle damper developed by the centre is an auxiliary-mass type of vibration absorber, where various types of particles (e.g., spherical particles, sand, powder and liquid particles) are placed in a cavity or a series of cavities attached to the primary structure to reduce the structural vibration. When the structure vibrates, the particles collide with each other and with the walls, and damping is resulting from inelastic or nearly inelastic collisions and friction between the particles. The rail particle damper can effectively suppress the broadband noise and vibration generated in various rail operating environments.

Figure 2: Laboratory and field experiment investigations and verifications



(a)



(b)

Figure 3: (a) Numerical model and simulation process; (b) Machine learning algorithm of rail particle damper

3. References to Research

Research output:

[R1] Luo, Y.K., Zhou, L., and Ni, Y.Q., Towards the understanding of wheel-rail flange squeal: In-situ experiment and genuine 3D profile-enhanced transient modelling, *Mechanical Systems and Signal Processing*, vol. 180, paper no. 109455 (2022).

[R2] Luo, Y.K., Chen, S.X., Zhou, L., and Ni, Y.Q., Evaluating railway noise sources using distributed microphone array and graph neural networks", *Transportation Research Part D: Transport and Environmen*t, vol. 107, page no. 103315 (2022).

[R3] Ye, X., Ni, Y.Q., Sajjadi, M., Wang, Y.W., and Lin, C.S., Physics-guided, data-refined modeling of granular material-filled particle dampers by deep transfer learning", *Mechanical Systems and Signal Processing*, vol. 180, paper no. 109437 (2022).

Patents:

[P1] Sajjadi Alehashem, S.M., Ni, Y.Q., Lin, C.S., and Zhang, C., A novel methodology for vibration and noise control using modular rail particle damper in rail transit systems. (Chinese patent, ZL 2021 1 0466428.5, Issued)

[P2] Sajjadi Alehashem, S.M., Ni, Y.Q., Lin, C.S., and Zhang, C., "Modular rail particle damper (MRPD) and damper's fixture for noise and vibration mitigation of railways". (Chinese patent, ZL 2021 2 0908352.2, Issued)

Related Research Grant:

[G1] Enhancing Safety, Punctuality and Ride Comfort of Railway Transportation: From Local Metro to Global High-speed Rail Network, Funded by The Research Grants Council of Hong Kong - Research Impact Fund (RIF), HK$8.43 million, 2019-2023.

[G2] Development of a Modular Rail Damper Based on Particle Damping Technology for Controlling Rail Corrugation Growth and Broadband Rolling Noise in Railways, Funded by The Innovation Technology Commission (ITC) of Hong Kong - Innovation and Technology Support Programme (ITSP), HK$1.39 million, 2022-2024.

4. Impact and Benefits

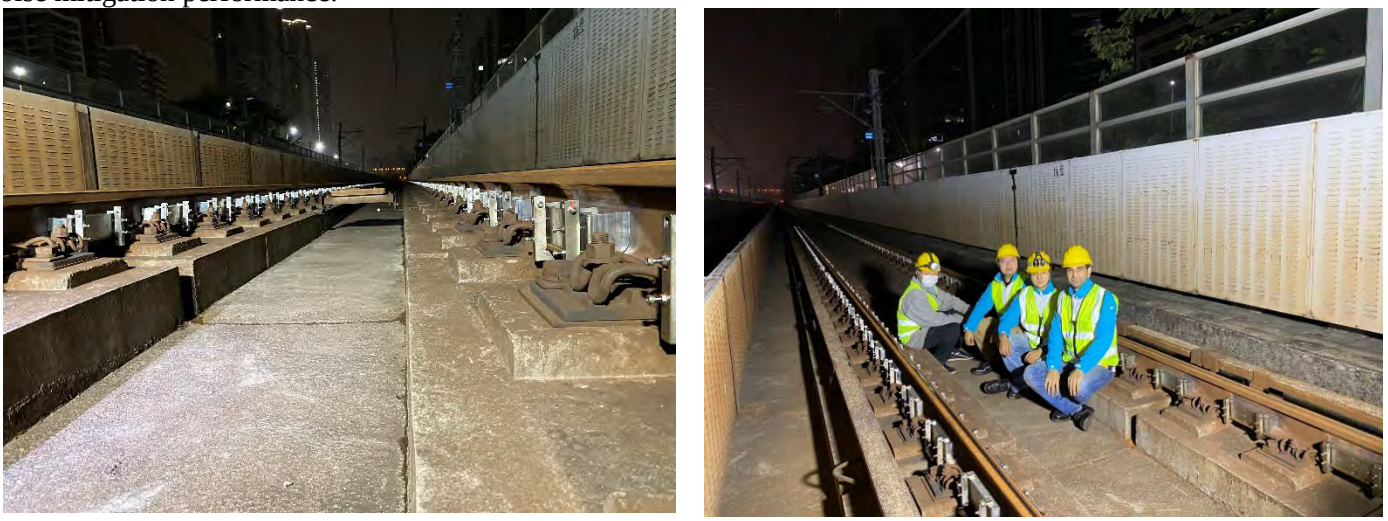
In recognition of PolyU's research outcomes in vibration and noise control of rail systems, our research team was invited to install modular rail particle dampers (MRPD) on Hangzhou Metro Line 3 to investigate MRPD performance. The test results indicated that MRPD can suppress broadband noise and vibration when trains pass.

Figure 4: In-situ experiment in Hangzhou Metro Line

In 2021, CNERC-Rail and Shenzhen Metro Group Co., Ltd. held several meetings on vibration reduction and noise suppression technology for rail transit and exchanged the feasibility and key technical issues on the application of rail particle dampers on Shenzhen metro operating lines. After conducting a series of safety assessments of the damper, Shenzhen Metro Group Co., Ltd. entrusted CNERC-Rail with applying the technology to a viaduct section of Shenzhen metro line 5.

CNERC-Rail members conducted in-situ measurements and monitoring at Shenzhen metro operating lines, where noise problems were found in some lines. Wheel–rail squeal noise is railway noise at extremely high frequency that causes great annoyance. It is generated by the imperfect alignment of the train and track through a sharp curve in the track. Reducing the train speed late at night is an ineffective mitigation method, and the squeal noise inevitably affects nearby residences adversely. A long period of exposure to squeal noise is demoralizing and potentially induces psychological illness. The research team implemented advanced methodologies, based on artificial intelligence, beamforming technique, and statistical analysis and integrated smart identification method to identify the wheel-rail squeal noise. Since September 2021, we have conducted comprehensive in-situ measurements for vibration and noise control studies on four Shenzhen metro lines.

In February 2022, the proposed MRPDs were implemented in Shenzhen Metro Line 5. This in-situ performance test of MRPDs on the rail vibration and noise control was the first-time implementation of the proposed particle damping technology to a viaduct section of an operating metro line, where the proposed MRPDs showed excellent vibration and noise mitigation performance.



Figures 5: In-situ MRPD performance test in Shenzhen Metro Line

To promote the noise and vibration control knowledge transfer in Hong Kong, CNERC-Rail has forged an intimate working partnership with Mass Transit Railway Corporation (MTR) to implement technical innovations and applications, and offer technological solutions in smart railway asset condition monitoring and intelligent maintenance. CNERC-Rail and MTR have carried out several feasibility studies on the implementation of rail particle dampers on the operating lines of Hong Kong MTR. MTR commissioned the centre to install the developed rail particle dampers at multiple stations of the MTR Tuen Ma Line, and the dampers will be implemented in more rail sections afterwards. At the same time, the two parties have signed a memorandum of understanding (MoU) on 14 June 2022 to further share advanced railway technologies between CNERC-Rail and MTR. The present technology is being commercialised, and owing to its excellent vibration and noise mitigation performance, it is expected to comprehensively improve the operational safety of subway systems. This is an example of the global trend of industry, universities and research institutions collaborating to realise knowledge transfer.

Figure 6: In-situ noise measurements at MTR Tuen Ma Line

Furthermore, CNERC-Rail team won the third prize in the National Innovation Centre of High-Speed Train Innovation and Entrepreneurship Competition, co-hosted by the National Innovation Centre of High-Speed Train and Qingdao Rail Transit Industry Demonstration Zone in September 2021. This competition aimed to solicit high-tech, high-innovation, high-potential projects in the field of rail transit from around the world. It was divided into innovation and entrepreneurship groups and attracted 377 teams from social research institutes, universities, enterprises and institutions, and scientific and technological innovation centres.

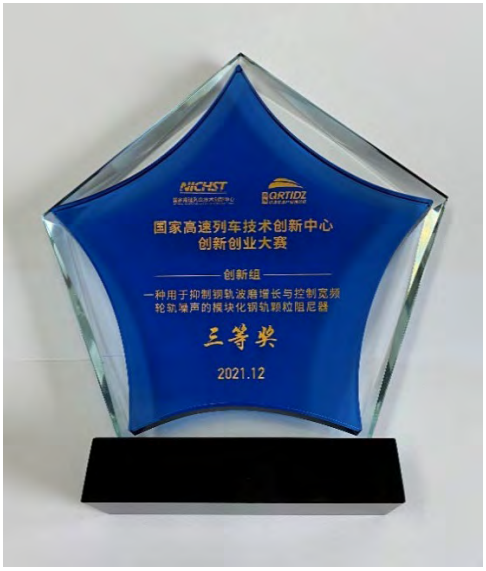


Figure 7: CNERC-Rail won the third prize in the Innovation and Entrepreneurship Competition of National Innovation Centre of High-Speed Train

5. References to the Corroboration of Impact and Benefits

[E1] Memorandum of Understanding Signing Ceremony between MTR, MTR Academy and The Hong Kong Polytechnic University 港鐵公司、港鐵學院與香港理工大學合作備忘錄簽署儀式 | CNERC-Rail (polyu.edu.hk):

Figure 8: Memorandum of Understanding Signing Ceremony between MTR, MTR Academy and The Hong Kong Polytechnic University

[E2] CNERC-Rail won the third prize in the Innovation and Entrepreneurship Competition of National Innovation Centre of High Speed Train 國家高速列車技術創新中心創新創業大賽：創新組三等獎 | CNERC-Rail (polyu.edu.hk): https://www.polyu.edu.hk/cnerc-rail/news-and-events/news/2022/20220107/

Figure 9: CNERC-Rail won the third prize in the Innovation and Entrepreneurship Competition of National Innovation Centre of High-Speed Train

Case 4: System inertia analysis and control for renewable penetrated power systems towards national dual carbon targets

1. Summary of the Impact

Building a clean, low-carbon, secure, and efficient energy system has been tasked in the National 14th Five-Year Plan as one of the key missions. A new power system focusing on renewable energy is a critical foundation for realising the national "carbon peaking" and "carbon neutrality" milestone. In building new power systems, the reduction of system inertia and deterioration of frequency stability in national and regional power grids have become a major problem limiting sustainable clean energy development strategy of core cities in the Guangdong-Hong Kong-Macao Greater Bay Area. In order to deal with this problem, China Southern Power Grid launched its first open call for Hong Kong and Macao organisations to undertake technology projects, which is the first attempt in the national energy industry.

PolyU was the only Hong Kong institutional awardee of the announced two projects. Led by Professor XU Zhao of the Department of Electrical Engineering and the Research Institute of Smart Energy (RISE), the project has been granted nearly CNY3.6 million to conduct "system inertia analysis and control for renewable penetrated power systems towards national dual carbon targets". The project will contribute to maintaining the secure and stable operation of power grids, large-scale development and utilisation of renewable energy, exploration of a long-term collaboration mechanism for scientific and technological innovation cooperation between Guangdong, Hong Kong and Macao, and supporting the evolution of the GBA into an international innovation and technology hub.

2. Underpinning Research

The Concept of Equivalent Inertia in New Power Systems

The evaluation and analysis of traditional power system inertia are mainly focused on synchronous generators. There is little research on the inertia response analysis of asynchronous machines, inverter-interfaced renewable energy systems, or other equipment with frequency responsive control in power systems that virtually contribute to system inertia. There is also a lack of quantitative analysis for their equivalent inertias. The existing power system inertia evaluation method mainly analyses the equivalent system inertia by detecting the system power change and corresponding rate of system frequency change, which is hardly applicable for new power systems with a high proportion and diversified renewable energies in the future.

Professor XU's team has proposed an innovative concept of "equivalent inertia" in the form of synchronous inertia, and quantified the inertias provided by asynchronous machines and inverter interfaced/DC renewable energy systems. The team was also able to analyse the equivalent inertia level for various new energy equipment based on the frequency response characteristics.

An Inertia Level Estimation Method for New Power Systems

In order to calculate the power shortage during grid disturbances, it is crucial to obtain the rate of frequency change at the centre of inertia. The existing methods rely on communications among multiple measuring points suffering from poor reliability and considerable time delay. Professor XU's team proposed a linear approach to calculate the frequency of the centre of inertia and its rate of change so as to determine the immediate system frequency response whenever an imbalance between generation and consumption occurs. In addition, in view of the difficulties in obtaining power and frequency information, the team will apply data mining technology and a graph-aware deep learning network to build a data model reflecting the relationships between system frequency, power imbalance and system inertia, so as to establish a data-driven power system inertia level estimation framework.

Frequency Stability Control strategies for New Power Systems under Carbon Reduction Goals

In order to improve the frequency stability of power systems with more and more electronics interfaced equipment, Professor XU's research team proposed two novel control strategies. The first strategy seeks to provide inertia support to the system through simultaneous utilization of DC-link capacitor energy and wind turbine (WT) rotor kinetic energy (KE). The second strategy supports system inertia through orderly exerting DC-link capacitor energy of WT and then WT rotor kinetic energy (KE) via a cascading control scheme. Both strategies can effectively provide system inertia support by fully utilizing WT's own potential, while the second strategy distinguishes itself by minimizing its impacts on wind energy harvesting.

3. References to Research

[1] X. Lye, Z. Xu, J. Zhao, K. P. Wong, "Advanced Frequency Support Strategy of Photovoltaic System Considering Changing Working Conditions", IET Proc. Power Generation Transmission and Distribution, 2018, Vol. 12 Iss. 2, pp. 363-370

[2] Y. J. Li, Z. Xu, K. P. Wong, "Advanced Control Strategies of PMSG-Based Wind Turbines for System Inertia Support", ***IEEE Transactions on Power Systems***, Vol. 32, No. 4, pgs 3027-3037, July 2017 （SCI Highly Cited Paper）

[3] Y.J. Li, Z. Xu, J. Østergaard, D. J. Hill, "Coordinated Control Strategies for Offshore Wind Farm Integration via VSC-HVDC for System Inertia Support", Volume: 32 Issue: 3 Pages: 843-856, **IEEE Transactions on Energy Conversion, Sep 2017**

[4] Y.J. Li, Z. Xu, "Coordinated Control of Wind Farms and MTDC Grids for System Frequency Support", ***Electric Power Components and Systems***, Volume: 45 Issue: 4 Pages: 451-464, 2017

[5] Y. J. Li, Z. Xu, J. L. Zhang, K. P. Wong, "Variable Gain Control Scheme of DFIG-based Wind Farm for Over-Frequency Support", Renewable Energy, Volume 120, May 2018, Pages 379-391

[6] Z. Xu, J. Østergaard, and M. Togeby,' Demand as Frequency Controlled Reserve', **IEEE Transactions on Power Systems,** Volume: 26 , Iss: 3, Aug. 2011, Page 1062-1071

4. Impact and Benefits

To maintain the stable operation of new power systems featuring a high proportion of renewable energy, Professor XU's research team has combined traditional power control theories with advanced deep learning studies to conduct system inertia analysis and develop coordinated control strategies for new power systems. A fundamental change compared to the traditional synchronous inertia estimation and analysis method, their study aims to build a real-time (within one second) inertia monitoring platform to achieve accurate and effective system monitoring.

The team has long been committed to research and development in smart grids and future power grids penetrated with high renewable energy. They have accumulated rich experiences in system inertia and frequency analysis, as well as applications based on big data and artificial intelligence. To help Nordic Power Grid tackle frequency disturbances due to high penetration of fluctuating renewable energy, the team has developed smart load control technologies to provide flexible system frequency support, of which the effectiveness in improving frequency stability and inertia level has been demonstrated in Nordic Power Grid.

Besides, Professor XU has also proposed a coordinated control strategy to improve the frequency stability of renewable energy power systems, especially wind turbines and photovoltaic (PV) systems. The proposed strategy can adjust the reference of electronic inverters per system power imbalance to support the system frequency, which meets the rapidity requirements of grid frequency support services. The control strategy could also effectively address the frequency fluctuations caused by renewable energy variations, contributing to the development of renewable energy and sustainable development of power systems.

5. References to the Corroboration of Impact and Benefits

[1] 南網 50Hz: https://zhuanlan.zhihu.com/p/504970518

南方电网首次设立港澳揭榜项目

[2] 環球網：https://m.huanqiu.com/article/47m2Ys1rJKG

环球网

“双高”“双随机”问题的实际需求出发而设置。两个项目以揭榜形式与港澳地区单位开展科技创新合作，这也是全国能源行业的首创，对粤港澳大湾区国际科技创新中心建设有着重要、积极的意义。

香港理工大学电机工程系许昭教授表示，这次南方电网揭榜港澳科技项目，香港理工大学智能电网团队将积极参与其中，努力成为建设粤港澳科技创新合作的坚实科研力量。

[3] 科技日報：http://digitalpaper.stdaily.com/http_www.kjrb.com/kjrb/html/2022-04/27/content_534357.htm?div=-1

科技日报

版面导航

南方电网面向港澳地区发布揭榜制科技项目

◎本报记者 刘传书

粤港澳特大型城市电网电力负荷密度大，受端电网特征突出，在新型电力系统背景下，“高比例可再生能源接入与高比例电力电子设备应用”“供给侧随机性和需求侧随机性”的“双高”“双随机”问题凸显，成为摆在粤港澳大湾区核心城市面前的共同难题。

4月25日，记者从第十八届中国南方电网国际技术论坛上获悉，南方电网首次开展面向港澳的科技项目揭榜，并充分发挥深圳“双区”建设的区位优势，由南方电网深圳供电局承接实施，探索粤港澳三地科技创新合作的长效机制，实现优势互补，合力解决碳达峰、碳中和背景下新型电力系统发展的关键共性问题，有效促进新能源大规模开发和利用。

“无论是南方电网，还是港澳地区科研力量，均已开展大量相关研究，三方的技术交流也十分密切，但为应对挑战，我们的合作还需进一步深化，科研的合力还需进一步增强。”南方电网公司创新管理部总经理李锐表示。

据了解，南方电网此次发布的两个揭榜项目，均从粤港澳特大型城市电网应对

[4] 羊城晚報：https://www.163.com/dy/article/H5TOLTLU0550AXYG.html

能源行业首创！南方电网面向港澳地区发布揭榜制科技项目

羊城派

75274 93768

往期回顾

大病不出区！白云区疑难急危重症救治中心正式成立

118家企业2000余岗位！广东民企高校携

Case 5: Development of new, stable, highly-efficient blue emissive materials that can be processed by wet methods and the associated large-area solid-state lighting technologies

1. Summary of the Impact

The development of the low-carbon, environment-friendly, and energy-saving lighting technology is essential to address the current energy and environmental crisis. White organic light-emitting diodes (WOLEDs) are a new generation of potential energy-saving lighting devices, with the advantages of surface emission, ultra-thin, and large area features. However, compared with the industrialized inorganic light-emitting diode lighting source and fluorescent lamp, WOLEDs are still lagging behind in terms of device efficiency, fabrication cost, and lifespan of the device. It is noteworthy that the all-evaporated WOLEDs are complicated to fabricate and have low product yields which hinder their market value, while solution-processed WOLEDs with the advantages of high material utilization, high energy efficiency, low manufacturing cost, and ease of large-area fabrication have become an effective approach.

To enhance the industrialization of solution-processed WOLEDs, there are three main key scientific issues to be addressed, including 1) The way how to reveal the structure-property relationship of blue emissive materials with new light emission mechanism; 2) the approach how to develop new molecular design strategies to prepare solution-processable, highly-efficient, stable blue emissive materials; and 3) the way how to realize large-area, high-performance WOLEDs through the reasonable device structure design and fabrication process.

This project focused on the development of new, stable, highly-efficient blue emissive materials that can be processed by wet methods and the associated large-area solid-state lighting technologies, including the design, synthesis and characterization of various blue light-emitting materials, with an aim to significantly promote the industrialization process of these technologies. This project will provide our country with new intellectual property rights, patents, and key technologies in the field of large-area solid-state lighting, also contributing to the global concerns such as energy and environmental issues, with long-term significance.

2. Underpinning Research

The project here takes basic research into the rational design and synthesis of new stable, highly-efficient blue emissive materials for large-area solid-state lighting.

(a) *Achieving sufficiently high power efficiency (PE) for solution-processed WOLEDs.* Currently, the PE of solution-processed WOLEDs is still moderate, ca. 20-25 lm/W at the practical high luminance of 1000 cd/m^2. Basically, high driving voltage issue of common solution-processed WOLEDs is the main problem. On the basis of an in-depth device design and energy-loss mechanism analysis of solution-processed WOLEDs, we plan to solve this issue by the exploration of the novel blue emitters and host materials, i.e. achieving solution-processed WOLEDs with PE in the range of 40-70 lm/W at the high luminance of 1000-3000 cd/m^2. After reaching this goal, cost-effective solution-processed WOLEDs can be energy-saving lighting sources, even superior to that of the commercial fluorescent tubes.

(b) *The scarcity of novel solution-processable blue emitters for WOLEDs.* High-efficiency solution-processable blue emitters are essential to the rational design of solution-processed WOLEDs targeting for high performance, e.g. high PE, high color-stability, high color rendering index (CRI), etc. On account of different processing methods and device structures for dry-processed WOLEDs and solution-processed WOLEDs, the requirements on materials are really different. With the richer knowledge on how to explore advanced solution-processed WOLEDs featuring high PE and high color quality, it is found that peculiar solution-processable blue emitters satisfying these features are really scarce. For example, there is a great demand for solution-processible blue emitters that are highly efficient but without aggregation-quenching (especially for blue emitters), and show adjustable HOMO/LUMO energy levels for obtaining solution-processed WOLEDs of low device driving voltage and high color stability. Moreover, the stability issues of solution-processible blue emitters will be considered for stable WOLEDs.

(c) *Fabrication and evaluation of large-area solution-processed WOLEDs.* At present, almost all research work in solution-processed WOLEDs was based on solution-processed WOLEDs of small device size fabricated via common methods such as spin-coating. Although high external quantum efficiency (EQE)/PE performance in solution-processed WOLEDs has been achieved for them, it is still unclear whether these materials and device structures explored are suitable

for large-area solution-processed WOLEDs. Accordingly, the correlated technical process and evaluation studies are also urgently required to disclose the key issues of science and technology and the corresponding tactics.

3. References to Research

Research Outputs:

[1] P. Tao, X. Lü, G. Zhou, W.-Y. Wong, Asymmetric *Tris*-Heteroleptic Cyclometalated Phosphorescent Iridium(III) Complexes: An Emerging Class of Metallophosphors, *Acc. Mater. Res.* **2022**, *3*, 830-842.

[2] P. Tao, W.-Y. Wong, Luminescent Transition-Metal Complexes and Their Applications in Electroluminescence, a chapter in *Comprehensive Inorganic Chemistry III* (3rd edition, editor: Vivian Wing-Wah Yam), Elsevier, **2023**, https://doi.org/10.1016/B978-0-12-823144-9.00106-0.

4. Impact and Benefits

Professor Raymond WONG's research innovation has significant impact and benefits to both academic and industrial communities. The anticipated benefits from the work range from the realm of the fundamental understanding of the chemistry involved and photophysical properties of these new materials to the realm of potential areas of application. It is conceived that these materials would pave the ways to developing the low-carbon, environment-friendly, and energy-saving lighting technology. The potential beneficiaries of the research in the short term are those researchers working in the academic field which will be given guidance in the future design of related luminescent materials. The potential beneficiaries in the medium term are tied with the economic, environmental and health aspects owing to the development of low-cost, environment-friendly materials for the realization of new products. In the longer term, the fundamental scientific values and high technological pay-off gained from these investigations would be important to the high-technology development and the future economy of Hong Kong and the Mainland.

5. References to the Corroboration of Impact and Benefits

YouTube
https://www.youtube.com/watch?v=19FdThmYxzU

Appendix 5: PolyU InnoHub / Entrepreneurship Activities

Event	Date	Partnering Organisation(s)
2 Jul 2021	2021 深創賽理大專場宣講會 暨【創投實驗室】第五期	深圳虛擬大學園 香港中文大學深圳研究院 香港 X 科技創業平臺 國奧科技（深圳）有限公司
5 Jul 2021	PolyU Micro Fund Scheme 2021 - 5-Week Lean Launchpad Programme- Week 3	-
12 Jul 2021	PolyU Micro Fund Scheme 2021 - 5-Week Lean Launchpad Programme- Week 4	-
23 Jul 2021	PolyU Lean Launchpad Programme briefing session	-
5 Aug 2021	2021 創新博士後深圳專案評審	-
6-8 Aug 2021	PolyU Maker Fund Hardware Bootcamp	-
27 Aug 2021	PolyU Orientation Info Day 2021 (virtual)	-
31 Aug 2021	PolyU Lean Launchpad Programme briefing session - awarded teams	-
1 Sep 2021	2021 深創賽理大專場市賽賽前輔導	深圳市科技服務業協會
3 Sep 2021	PolyU Lean Launchpad Programme Bootcamp (Week 1) - Bootcamp	-
4 Sep 2021	PolyU Lean Launchpad Programme Bootcamp (Week 1) - Bootcamp	-
4-30 Sep 2021	MVP & Market Validation Training	-
9 Sep 2021	TLF 2022-23 Briefing Session	-
14 Sep 2021	Briefing to MF Awardees	-
20 Sep 2021	PolyU Lean Launchpad Programme (Week 2)	-
27 Sep 2021	PolyU Lean Launchpad Programme (Week 3)	-
4 Oct 2021	PolyU Lean Launchpad Programme (Week 4)	-
11 Oct 2021	PolyU Lean Launchpad Programme (Mid Term Review Week 5)	-
18 Oct 2021	PolyU Lean Launchpad Programme (Week 6)	-
19 Oct 2021	【創投實驗室】第六期暨導師 1V1	環球律師事務所
20 Oct 2021	PolyU InnoHub x HKAI Lab Webinar: AI Technology and Career Opportunities	HKAI Lab
25 Oct 2021	PolyU Lean Launchpad Programme (Week 7)	-
25 Oct 2021	深圳天使母基金—理大深圳基地 科技成果轉化交流會	深圳市天使投資引導基金管理有限公司
29 Oct 2021	The Marker Connect	-
1 Nov 2021	PolyU Lean Launchpad Programme (Week 8)	-
8 Nov 2021	PolyU Lean Launchpad Programme (Week 9)	-
17 Nov 2021	PolyU InnoHub x Huawei Webinar_The Future of App Industry	Huawei
26 Nov 2021	PolyU Lean Launchpad Programme Final Presentation (Week 10)	-
6 Dec 2021	Go Business Tokyo Seminar	Tokyo Metropolitan Government, Invest Tokyo
17 Dec 2021	PolyU Innovation Challenge - Pre-Mixer	Chinachem Group, Esri China (Hong Kong), HKT
17 Dec 2021	PolyU Innovation Challenge	Chinachem Group, Esri China (Hong Kong), HKT
22 Dec 2021	TLF 2022-23 Investment Panel Meeting	-

Event	Date	Partnering Organisation(s)
23 Dec 2021	創業中心微信小程式培訓交流會	廣州萬戶網路科技有限公司
3-8 Jan 2022	Hong Kong Techathon 2022	HKSTP, CityU, HKBU, LingU, CUHK, HKUST, HKU
12 Jan 2022	2022【“灣”有引力 與“理”同行】第 I 期-灣區創業團隊線上交流會	深圳市科技創新戰略研究與技術轉移促進中心 奧弗(深圳)科技有限公司 佳昇科技有限公司
20 Jan 2022	深圳市科技創新戰略研究與技術轉移促進中心 奧弗(深圳)科技有限公司 佳昇科技有限公司	深圳市小劇一下文化創意有限公司
8 Feb 2022	POC 2022(1) Briefing Session	-
12 Feb 2022	iDM2 Training on "Market Validation and Value Proposition"	-
12 Feb 2022	LLP Training (Week 1)	-
17 Feb 2022	LLP Training (Week 2)	-
19 Feb 2022	iDM2 Training on "New Product Introduction, Product Management and Manufacturing"	-
1 Mar 2022	PolyU Micro Fund Scheme 2022 - Online Briefing Session I	-
3 Mar 2022	LLP Training (Week 3)	-
12 Mar 2022	iDM2 Training on "Printed Circuit Board (PCB) Design & Electronics"	-
17 Mar 2022	LLP Training (Week 4)	-
18 Mar 2022	POC 2022(1) Bootcamp - Day 1	-
19 Mar 2022	POC 2022(1) Bootcamp - Day 2	-
19 Mar 2022	iDM2 Training on "Hardware and Software Integration"	-
22 Mar 2022	POC 2022(1) Introductory training on ”Location and Geospatial Intelligence” - Day 1	Esri China (Hong Kong)
23 Mar 2022	POC 2022(1) Introductory training on ”Location and Geospatial Intelligence” - Day 2	-
24 Mar 2022	POC 2022(1) Introductory training on ”Location and Geospatial Intelligence” - Day 3	-
24 Mar 2022	GBA Startup Postdoc Programme - Online Briefing Session	-
29 Mar 2022	PolyU Micro Fund Scheme 2022 - Online Briefing Session II	-
31 Mar 22	LLP Training (Week 5)	-
Late Mar -Early Apr 2022	POC 2022(1) Mentoring Session	-
4 Apr 2022	PolyU InnoHub x HKAI Lab Webinar: AI Technology and Career Opportunities	HKAI Lab
14 Apr 2022	LLP Training (Week 6)	-
28 Apr 2022	LLP Training (Week 7)	-
21 May – 5 Jun 2022	PolyHack	Google Developer Student Club
26 May 2022	Online Workshop: Startups' Guide - Accounting 101	-
27 May 2022	PolyU Micro Fund Scheme 2022 - 5-Week Lean Launchpad Programme- Bootcamp Day 1	-
28 May 2022	PolyU Micro Fund Scheme 2022 - 5-Week Lean Launchpad Programme- Bootcamp Day 2	-
16 Jun 2022	2022 创新博士后深圳项目评审会	-
24 Jun 2022	Health Future Challenge - Briefing Session	-

Event	Date	Partnering Organisation(s)
29 Jun 2022	2022 深創賽深港澳高校預選賽 暨首屆大灣區可持續發展創新挑戰賽宣講會	香港中文大學深圳研究院 理大玻璃技術（深圳）有限責任公司

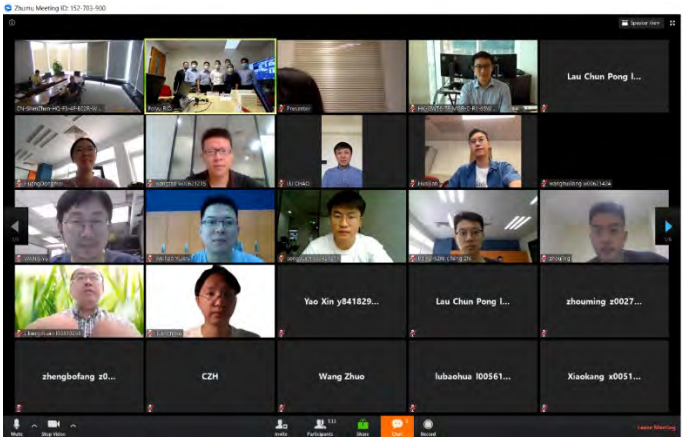
Appendix 6: List of Awards Won by PolyU Start-ups

Startups/ Startup Founders	Awards
Medmind Technology Limited (PolyU Micro Fund Scheme 2018)	Hong Kong ICT Awards 2021 - Smart People (Smart Ageing) Award - Bronze Award Hong Kong Social Enterprise Challenge 2021-22 - Champion
Master Edutainment (PolyU Micro Fund Scheme 2016)	香港中小企創新大獎 2021 - 中小企業逆轉創新大獎銀獎
BUILDING INTEGRATION PERFECTION LIMITED (PolyU Micro Fund Scheme 2012; China Entrepreneurship Fund 2018; PolyU Tech Launchpad Fund (TLF) Scheme 2021)	2021 前海粵港澳台青年創新創業大賽（香港賽區）- Second Runner-up
深圳帕格精密系统有限公司 (STEFG-PolyU China Entrepreneurship Fund 2014)	NextGen Supply Chain Conference - 2021 NextGen Supply Chain Solution Provider Awards
Asiabots Ltd (PolyU Tech Launchpad Fund (TLF) Scheme 2018)	Hong Kong ICT Awards 2021 - 2021 Smart Retail Tech Award 2021 (Technology Startup)
Blue Pin (HK) Limited (PolyU Micro Fund Scheme 2019; PolyU Tech Launchpad Fund (TLF) Scheme 2020)	Smart Mobility (Smart Tourism) Award - Bronze Award Smart Living Partnership Awards 2021 - Outstanding Smart Hotel Enablement Solution Award
Flow Entertainment Limited (PolyU Micro Fund Scheme 2019)	Winner of HKTDC Start-up Express 2022 (Smart City)
ARISE EDUCATION LIMITED (PolyU Tech Launchpad Fund (TLF) Scheme 2020)	Hong Kong ICT Awards 2021 - ICT Startup (Social Impact) Award - Bronze Award
Grand Rise Technology Limited (PolyU Tech Launchpad Fund (TLF) Scheme 2020, 2022)	2021 纳米功能材料创新创业大赛最具投资价值奖一等奖 Environmental Impact Award - JUMPSTARTER AWARD 2022
WIN VICTORY ENTERPRISES (PolyU Tech Launchpad Fund (TLF) Scheme 2020)	Hong Kong ICT Awards 2021 - ICT Startup (Software and Apps) Award - Bronze Award
Innospire Technology Limited (PolyU Micro Fund Scheme 2020)	City I&T Grand Challenge - Innovation Award Smart People (Smart Inclusion) Award - Bronze Award
ZHIZI AI Education (Shen Zhen) Limited (PolyU Micro Fund Scheme 2020)	2022 Geneva International Exhibition of Inventions Bronze medal

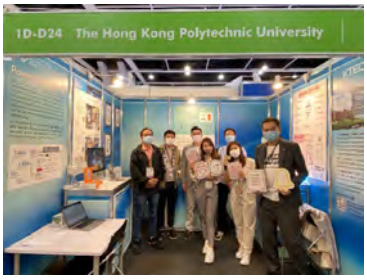
Startups/ Startup Founders	Awards
CLAIRE Clinical AI Research Limited (PolyU Micro Fund Scheme 2020)	Startup Express Pitching Contest 2021 – Winner MIT HealthHACK - Future of aging (Caregiver support) – Awardee HSBC Future Skills Development Project - Championship and Most Feasible Video Award Student Innovation (Tertiary or above) Award - Bronze Award The 8th HK University Student Innovation & Entrepreneurship Competition-2nd Prize (Social Enterprise)
Guangdong Moogoo Biotechnology Ltd (PolyU Micro Fund Scheme 2020, PolyU Tech Launchpad Fund (TLF) Scheme 2021, 2022)	深圳大学"双创领航精英训练营"路演比赛 - First Award 2022 Geneva International Exhibition of Inventions Silver medal
Project 'Computing Learning Channel' (PolyU Student Entrepreneurial Proof-of-Concept Funding (POC) Scheme 2020)	Annual Student OER Contest - First Prize
SENTOR EDUCATION COMPANY LIMITED (PolyU Micro Fund Scheme 2021)	City I&T Grand Challenge - Innovation Award
Bridge AI Limited (PolyU Micro Fund Scheme 2021)	Myth Focus Hong Kong Most Valuable Corporate Awards 2021 - Most Trusted Education Centre For (SEN) Children of The Year Asia Social Innovation Award 2021: Futuremaker of the Year 2021 Hong Kong Social Enterprise Challenge (HKSEC) 2021-22 – Champion Hong Kong Social Enterprise Challenge (HKSEC) 2021-22 - Timely Impact Award Hong Kong Social Enterprise Challenge (HKSEC) 2021-22 - Youth Co:Lab HKSAR Winners 2022 International Exhibition of Inventions of Geneva - Silver Medal
Project 'Intelligent driver health assessment system based on the optical fiber interferometer' (PolyU Student Entrepreneurial Proof-of-Concept (POC) Funding Scheme 2020)	第 17 屆"挑戰盃"全國大學生課外學術科技作品競賽(港澳地區) - 三等獎
Project 'Online platform to sell fruits of high quality' (PolyU Student Entrepreneurial Proof-of-Concept (POC) Funding Scheme 2020)	第 7 屆中國國際「互聯網+」大學生創新創業大賽銅獎

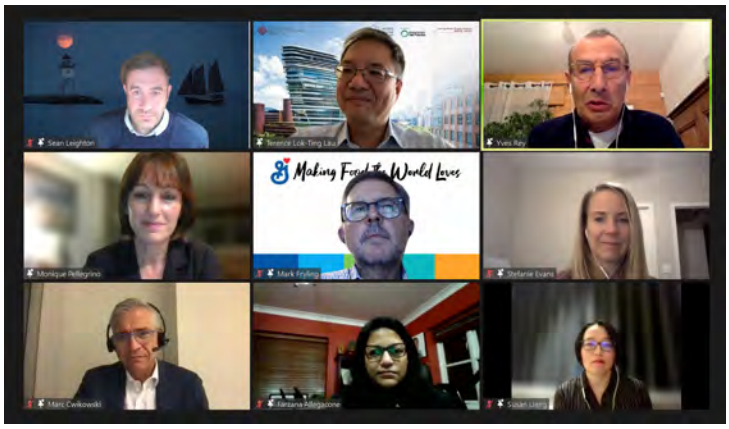
Startups/ Startup Founders	Awards
MYCROFT PADISON LTD. (PolyU Student Entrepreneurial Proof-of-Concept (POC) Funding Scheme 2020)	第 7 屆中國國際「互聯網+」大學生創新創業大賽銅獎
Project '爱而思（E'ELRILS）' (PolyU Student Entrepreneurial Proof-of-Concept (POC) Funding Scheme 2020)	第 7 屆中國國際「互聯網+」大學生創新創業大賽銅獎 2021 前海粵港澳台青年創新創業大賽香港區比賽（大專組）銅獎
Project 'Habits Log' (PolyU Student Entrepreneurial Proof-of-Concept (POC) Funding Scheme 2020)	第 17 屆"挑戰盃"全國大學生課外學術科技作品競賽(港澳地區) - 三等獎
GABES LIMITED (PolyU Maker Fund Programme 2021)	PolyU Innovation Challenge - Champion
iMeddy Limited (PolyU Tech Launchpad Fund (TLF) Scheme 2022, PolyU Student Entrepreneurial Proof-of-Concept (POC) Funding Scheme 2020)	City I&T Grand Challenge 2021 - Innovation Award 第 7 屆中國國際「互聯網+」大學生創新創業大賽銀獎 The 8th Hong Kong University Student Innovation and Entrepreneurship Competition-2nd Prize (Startup)
Project 'Smart Stair-climbing Wheelchair' (PolyU Student Entrepreneurial Proof-of-Concept (POC) Funding Scheme 2022)	The 8th HK University Student Innovation & Entrepreneurship Competition-3rd Prize (Entrepreneurship)
Quartermaster (PolyU Student Entrepreneurial Proof-of-Concept (POC) Funding Scheme 2022)	The 8th HK University Student Innovation & Entrepreneurship Competition-2nd Prize (Entrepreneurship)
Project 'Mutual Cognitive Human-Robot Collaborative System' (PolyU Student Entrepreneurial Proof-of-Concept (POC) Funding Scheme 2022)	The 8th HK University Student Innovation & Entrepreneurship Competition-2nd Prize (Entrepreneurship)

Appendix 7: Marketing, Networking and Engagement Activities

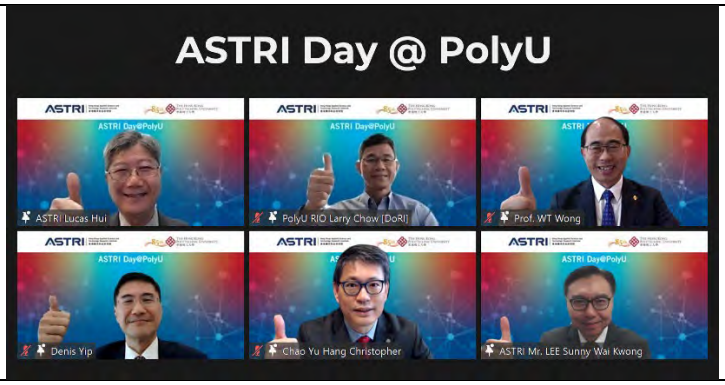
Date	Event	Photo
Aug 2021	**Microelectronics Technology Forum** The Hong Kong Polytechnic University (PolyU) co-organised the Microelectronics Technology Forum (MTF) with the newly founded Semiconductor Nanotechnology Alliance, industrial partners and other 4 local universities on August 2021. The Forum connected notable professionals from universities, tech start-ups, investors, and world-leading corporations to explore opportunities brought by the emerging microelectronics technologies. The 3-day inspirational hybrid event has attracted over 600 participants from more than 20 countries/regions, in which half of them are C-level executives, directors, well-known scholars, academicians as well as government officials.	
Aug 2021	**PolyU Huawei Annual Workshop** The PolyU Huawei Annual Workshop on Optical Communications online workshop has attracted over 190 engineers from Huawei and researchers from PolyU. Latest research findings on topics such as advanced camera and display algorithms and systems, data centre network and high-speed transmission systems, specialty optical fiber, etc. have been discussed during the workshop.	
Aug 2021	**PolyU - Dongguan Technology Exchange Webinar** HK PolyU Research and Innovation Office and the Dongguan Science and Technology Bureau (STB) jointly organised a technology exchange webinar to foster the communication and research collaboration among the academia of PolyU and industries of Dongguan.	

Sep 2021	**2021 Jiangsu-Hong Kong InnoTech Webinar** The Hong Kong Polytechnic University (PolyU) has co-organized and presented the latest technology advancement in the area of biotechnology, aviation as well as advanced lighting and imaging system at the Jiangsu-Hong Kong InnoTech Webinar which was for technology exchange between Hong Kong and Jiangsu. More than 2,100 online and offline attendees from 45 Jiangsu companies of different industries have joined the webinar and some showed interests in exploring research collaboration with our researchers.	
Sep 2021	**GBA PolyVentures 2025 Strategic Partnership MoU Signing Ceremony** PolyU signed MoU with three strategic partners, namely Everbright Limited, StartupHK Fund and Hai Robotics to further propel the "GBA PolyVentures 2025" blueprint laid down by the University to leverage PolyU's experience in innovation and entrepreneurship education to provide the necessary support for nurturing deep tech ventures and accelerating their growth. The collaboration also aims to translate research excellence into societal impact to contribute to the development of innovation and technology in the GBA.	
Sep 2021 - May 2022	**CEO PolyVentures Series of Webinars and Talks** The CEO PolyVentures Series focused on PolyU research being transformed into impact through knowledge transfer and commercialisation. The webinars and talks facilitated an exchange between academics and industry partners, they also showcased PolyU's research excellence in specialised expert areas, such as anti-COVID applications and energy-free smart cooling, attracting extensive participation from Hong Kong, Mainland China and overseas. They also featured PolyU start-ups led by PolyU academics and researchers.	  
Oct 2021	**TechConnect World 2021** PolyU research teams excelled in the area of "Materials & Manufacturing" and "AI, Data, Cyber & Software" winning three TechConnect 2021 Global Innovation Awards.	

Oct 2021	**Asia Summit on Global Health 2021** In the fireside chat "Resilient Public Health System for the Future: Part I," Associate Professor of Department of Health Technology and Informatics Dr. Gilman Siu, together with other speakers, shared with the audience on what the global community have learned from the COVID-19 pandemic, and what are the key elements in preparing the public health system against infectious diseases.	
Oct 2021	**InnoCarnival 2021** The PolyU pavilion at the nine-day exhibition showcased the University's award-winning technologies covering healthcare, environmental monitoring, smart cities and automotive safety. Some of them have already been commercialised through PolyU-supported start-ups.	
Oct 2021	**PolyU Maker Connect: Design x Tech x Manufacture** Held at the newly revitalised Central Market, PolyU Maker Connect was a vibrant networking occasion where young entrepreneurs, I&T talents, designers and industrialists interconnected and explored collaborations. It featured the award presentation to 12 PolyU hardware start-up teams supported under PolyU Maker Fund Programme 2021 and the introduction of SD Plus (SD+), a knowledge transfer unit of SD, with the appointment of five young designers as SD+ Ambassadors.	
Oct – Nov 2021	**Tradeshows in Hong Kong and Mainland China** A total of 14 PolyU-nurtured startups were showcased in HKTDC Electronics Fair (Autumn Edition), Hong Kong International Medical and Healthcare Fair, International ICT Expo, as well as the online version of China Hi-Tech Fair. These young and promising companies presented their innovations and technologies to visitors from industry and the general public, and even to the audience of exhibitors' forums.	 

Nov 2021	**China International Food Safety and Quality Conference 2021** PolyU's Food Safety Consortium [FSC] and Research Institute for Future Food [RiFood] joined force to promote PolyU's food safety capabilities and explore collaboration opportunities. Dr. Terence Lau, Convener of FSC co-chaired the plenary panel discussion with the topic of "Manufacturer's Horizon Scanning of Future Food & Food Safety Trends" and breakout session "Safety Evaluation of Substances Used for Both Food & Drug (TCM) in China."	
Nov 2021	**GIES 2021** PolyU showcased a wide spectrum of stunning Elderly-Friendly technologies at the Gerontech and Innovation Expo cum Summit 2021 (GIES), mainly from Department of Biomedical Engineering, School of Nursing and Jockey Club Design Institute for Social Innovation (JCDISI).	
Dec 2021	**大灣區工程師論壇** The 2021 Greater Bay Area Engineers Forum was successfully held simultaneously in Hong Kong and the Guangdong-Macau In-depth Cooperation Zone in Hengqin on 5 December 2021. The theme of the Forum was "bringing engineering elites together to foster Greater Bay Area development". The hybrid event was composed of three forums and one seminar. The event was well received, with more than 500 engineering experts attending.	
Dec 2021	**Sustainable_City_Lecture_Series-French_Consulate S3** Co-hosted by the Consulate General of France in Hong Kong and Macau, and the Research Institute for Sustainable Urban Development (RISUD) and the Research Innovation Office (RIO) of The Hong Kong Polytechnic University, the third conference held within the "Sustainability Lecture Series: The Decarbonisation Challenge" will bring together a mix of speakers from academic and business community to share their views, experiences and good practices towards sustainability.	

Dec 2021	**PolyU-Huawei MoU Signing** PolyU and Huawei signed a strategic research cooperation memorandum of understanding today. Based on the existing cooperation, Huawei and PolyU's newly established Photonics Research Institute jointly advance the technology development of photonics and its applications, by pursuing in-depth research collaborations to address major social challenges, setting up a joint lab and cultivating more young talents and organising joint academic activities.	
Dec 2021	**PolyU Avalon Polytom Cheque-Presentation** The anti-cancer drug candidate Pegtomarginase, initially developed by the research team led by Professors Thomas Leung and Thomas Lo in the Department of Applied Biology and Chemical Technology and Lo Ka Chung Research Centre for Natural Anti-Cancer Drug Development, is further developed and exploited by Avalon Polytom and Athenex for the treatment of patients with advanced malignancies. They received U.S. FDA allowance of Investigational New Drug (IND) Application in 2019, and this second-generation human arginase is granted to enter clinical trial phase 1, a significant milestone for this drug development with researchers' innovation and strong execution capabilities at the company's commitment to commercializing novel technologies for the treatment of a wide range of cancers.	
Dec 2021	**Partnership with CMA** PolyU's senior management paid a couple of exchange visits to The Chinese Manufacturers' Association of Hong Kong (CMA), as well as the CMA+ technology commercialisation centre and its laboratories in Fo Tan Industrial Zone. The exchange and the discussions between PolyU delegates and CMA's senior executives greatly deepened mutual understanding between the two parties, paving the way for further collaboration in future.	

Dec 2021 - Jan 2022	**Partnership with EMSD** PolyU collaborated with the Electrical and Mechanical Services Department (EMSD), HKSAR to promote the adoption of innovation and technology by participating in their signature events. At the E&M I&T Day 2021, PolyU featured its smart building and smart city solutions and a PolyU-supported start-up at the conference and the exhibition. At EMSD Symposium 2022, PolyU showcased its Smart City Platform, green mobility technology and three research institutes through the online exhibition and the webinar.	  
Mar 2022	**Special Edition 2022 Inventions Geneva Evaluation Days – Virtual Event** PolyU participated in the prestigious invention expo with four PolyU supported start-ups and two academic projects from different disciplines, garnering six awards. The result generated wide publicity coverage.	
Apr 2022	**ASTRI-PolyU MoU** The Hong Kong Polytechnic University (PolyU) and The Hong Kong Applied Science and Technology Research Institute (ASTRI) have signed a Memorandum of Understanding (MoU) to strengthen collaboration on research and technology transfer as well as to nurture future R&D talent, leveraging the research expertise of both parties.	
Apr 2022	**ASTRI-PolyU-Day** ASTRI Day@PolyU co-organised by The Hong Kong Polytechnic University (PolyU) and the Hong Kong Applied Science and Technology Research Institute (ASTRI) was successfully held on 13 April. The event was well-received with around 100 PolyU students attending online.	

May 2022	**PolyU-Huawei AI (Asia Pacific) MoU** The Hong Kong Polytechnic University (PolyU) and Huawei AI signed a Memorandum of Understanding (MoU) at the Huawei APAC Digital Innovation Congress 2022. The partnership aims to foster innovation and technology development in Hong Kong by strengthening industry-academic exchange and talent cultivation in artificial intelligence.	
Jun 2022	**MoU Signing with FHKI** PolyU and the Federation of Hong Kong Industries (FHKI) signed a memorandum of understanding (MoU) to deepen their partnership and foster university-industry collaboration. With the aim of nurturing innovation and technology (I&T) talent and supporting start-ups, the partnership will focus on promoting the exchange of industry insights and addressing I&T needs over the coming year.	
Jun 2022	**PolyU-MTR MoU** The MTR Corporation and MTR Academy (MTRA) signed a Memorandum of Understanding ("MoU") today with The Hong Kong Polytechnic University ("PolyU") on a three-year collaboration to establish a partnership to focus on exploring advanced and innovative railway technologies and facilitating smart railway asset and operations management, as well as intelligent maintenance.	
Jun 2022	**PolyU-Increasepharm Joint Research Lab** PolyU has a robust research community in Chinese Medicine. PolyU's Research Centre for Chinese Medicine Innovation (RCMI) and Increasepharm (HK) Limited announced the establishment of the PolyU-Increasepharm Joint Research Laboratory for New Drug Development. With the generous support of HK$10 million from Increasepharm (HK) Limited, the joint lab will develop CM-based new drug for the coming 5 years to treat osteoporosis, sarcopenia, dementia, and ocular diseases. Through the close collaboration with Increasepharm, it is hoped to seize the strategic opportunities to integrate with the country's overall development, further advanced drug discovery and development in view of the surging demand in healthcare and pharmaceutical industry.	

Jun 2022	**Visit of HKEAIA** A delegation from Hong Kong Electrical Appliance Industries Association (HKEAIA) visited the University Research Facility in 3D Printing, Jockey Club Smart Ageing Hub and PolyU Cyber-Physical Systems Laboratory. The delegates met with some PolyU academics and gained an understanding of the University's latest research on noise and vibration control in home appliances, flexible energy materials, and logistics and enterprise engineering. The two parties had a fruitful discussion and exchanged ideas about the pain points of the industry.	
Jun 2022	**TechConnect World 2022** The Hong Kong Polytechnic University (PolyU) has won three prestigious global Innovation Awards in the areas of artificial intelligence (AI), materials science and biotechnology at the TechConnect World Innovation Conference and Expo 2022 (TechConnect) – the world's largest multi-sector event for fostering the development and commercialisation of innovations. This is the sixth consecutive year that PolyU research teams have snatched the esteemed awards among top-ranked innovators, and PolyU is the only higher education institution in Hong Kong to be honoured with the awards this year.	
Jun 2022	**YIRA** PolyU Young Innovative Researcher Award (YIRA) is a university-level award to recognize young faculty members whose researches demonstrate excellence in addressing global challenges. As the inaugural round, we have received 59 submissions across 22 departments covering all faculties and schools. 6 researchers are selected and a research funding support of HK$500,000 and personal cash prize of HK$20,000 are given as the encouragement for their research excellence.