ASTRI

ANNUAL REPORT 2021-2022

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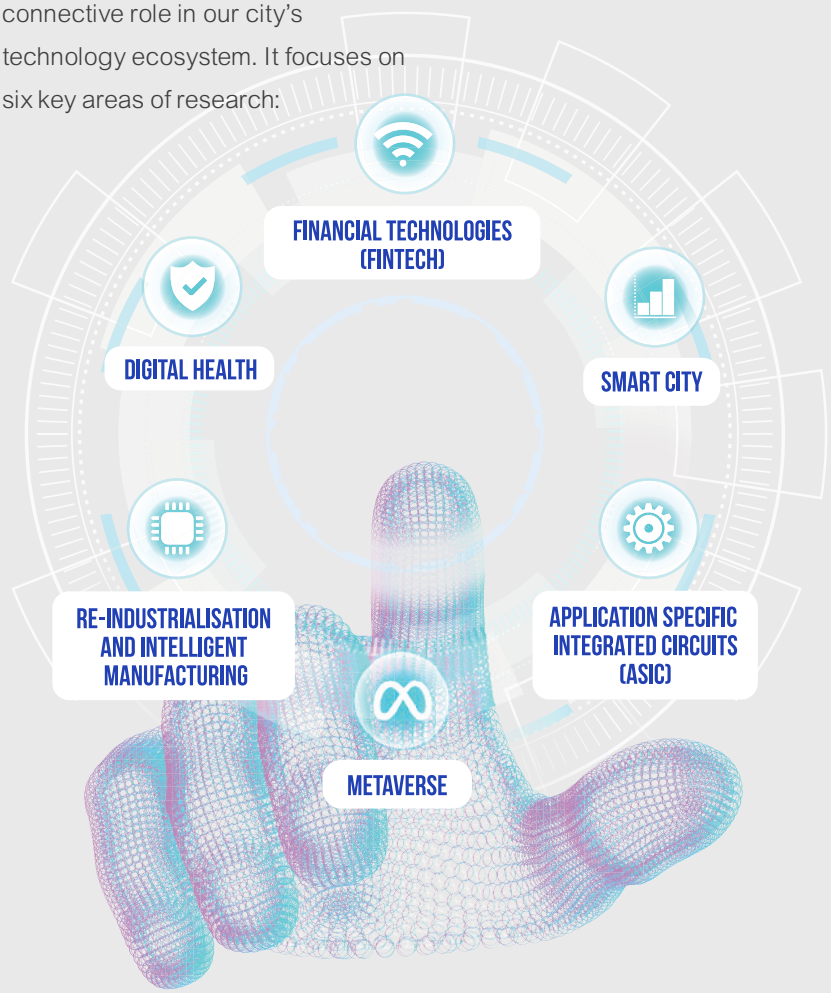
THE ASTRI STORY

For the past 22 years, the Hong Kong Applied Science and Technology Research Institute (ASTRI) has been deeply involved in the transformation of Hong Kong.

Founded by the Hong Kong SAR Government in 2000, ASTRI's mission is to enhance the city's competitiveness through applied research. It is Hong Kong's dedicated R&D centre for Information and Communication Technologies (ICT), designated as such by the Government in 2006.

ASTRI acts as a vital bridge connecting two ends of the ICT spectrum: academics pursuing ICT research, and industries looking to apply ICT technologies.

ASTRI is thus playing an essential connective role in our city's technology ecosystem. It focuses on six key areas of research:



ACHIEVEMENTS AT A GLANCE

Since 2000, ASTRI has:

Completed
1000+
research projects

Been granted
1000+
patents for its innovations

Transferred
1250+
technologies to different industries

Won numerous
AWARDS
for its technological contributions

A NEW CHAPTER IN COMMERCIALISATION

ASTRI aligns itself with 14th Five-Year Plan and Government's I&T strategy

The year 2021 kicked off China's 14th Five-Year Plan, which provides a blueprint and action agenda for national development from 2021 to 2025. Importantly for Hong Kong's innovation and technology (I&T sector), this was the first of China's Five-Year Plans to explicitly support the development of Hong Kong into an international I&T hub.

In line with the 14th Five-Year Plan and the HKSAR Government's strategic I&T blueprint for Hong Kong, ASTRI has realigned its mission and vision, and brought forward a number of new initiatives to support it. ASTRI's new strategic directions include commercialisation enhancement, talent cultivation, ecosystem collaboration, and GBA connectivity. They are being realised in steps such as:

THE STEPPING UP OF COMMERCIALISATION ACTIVITIES

THE LAUNCH OF VARIOUS GLOBAL PROGRAMMES TO ATTRACT TALENTS

THE ESTABLISHMENT OF NEW RESEARCH COLLABORATIONS WITH UNIVERSITIES

THE CREATION OF A STRONGER PRESENCE IN THE MAINLAND, AND EXPANDED TIES WITH I&T ECOSYSTEM PLAYERS

COMMERCIALISATION ENHANCEMENT

Amplifying ASTRI's commercialisation impact

Enhancing Hong Kong's global technological competitiveness begins with technology commercialisation – turning research ideas into commercially viable outcomes. ASTRI measures its commercialisation impact on the basis of the total contributions it receives from industry to carry out technology research and/or technology transfer. ASTRI has rolled out various new schemes to increase its research commercialisation:

- **EXPANSION OF CORE R&D INITIATIVES**

  Metaverse is added to ASTRI's existing core initiatives from 2022. Its new matrix includes Smart City, FinTech, Digital Health, Re-industrialisation and Intelligent Manufacturing, Application Specific Integrated Circuits (ASIC), and Metaverse.

- **TECH ECOSYSTEM REINFORCEMENT**

  ASTRI continues to launch strategic initiatives in some key areas that will benefit the entire tech ecosystem. Examples include its FinTech Ecosystem, its Advanced Semiconductors Consortium, its Smart Mobility solution C-V2X (with plans to expand into the Greater Bay Area (GBA)), and its IoT Sensing and AI technologies for digital health and re-industrialisation.

- **STRENGTHENING OF CLIENT ENGAGEMENT**

  ASTRI is stepping up its engagement with multinational corporations and conglomerates, to solve business pain points experienced by public and private sector clients. It is also organising tailored technology marketing workshops with industry associations, universities, InnoHK R&D centres, technology start-ups and MSME (Micro, Small and Medium Enterprises) communities, to identify opportunities for further engagement.

- **NEW MODEL OF RESEARCH COLLABORATION**

  ASTRI is adopting a more ecosystem-centric approach to commercialising its technologies. This involves conducting joint research and commercialisation with universities and InnoHK R&D Centres with IP co-ownership, strengthening ecosystem partnerships across key technology areas, and linking with downstream industry partners across GBA.

TALENT CULTIVATION

Identifying and empowering the next generation of tech talents

By attracting and training a talented technology workforce and partnering with academia and industry, ASTRI is performing the role of a "partnerships architect" for the ecosystem. Its series of initiatives to enlarge the I&T talent pool include:

- **a newly-launched Fintech Future Leader Academy to foster a fintech-savvy workforce**
- **a new Top Technology Scholar Programme to attract and retain tech talents**
- **an expanded talent acquisition programme targeting key universities, to attract high calibre people worldwide**
- **an expanded summer internship programme targeting key universities worldwide**
- **(in the pipeline) a series of ASTRI career sessions at top universities in Hong Kong and the Mainland**

ECOSYSTEM REINFORCEMENT

Enhancing ASTRI's R&D collaboration with academia and InnoHK research clusters

ASTRI's R&D initiatives are often carried out in collaboration with partners from universities and research clusters. The idea is to leverage the patent technologies and research strengths of each party to drive cross-disciplinary R&D collaboration and achieve impactful innovations.

ASTRI introduces a new paradigm of intellectual property (IP) co-ownership with its recent signing of an MoU with The Hong Kong University of Science and Technology (HKUST). The two parties will work jointly to commercialise their R&D deliverables for Smart City development.

We are also actively exploring joint research opportunities with the InnoHK R&D centres, a major Government initiative aimed at making Hong Kong a hub for global research collaboration. We are looking to complement each other across basic and applied research to create value that benefits all of society, and are expecting the first collaboration to get underway in 2022.

GBA CONNECTIVITY

Strengthening ASTRI's presence in the Mainland and its ties with I&T ecosystem players

ASTRI is expanding its activities in the Mainland, and is considering establishing a presence in the Shenzhen Branch of the Hong Kong Science Park in Futian and the Lok Ma Chau Loop as a way of strengthening its collaboration with ecosystem stakeholders and industry partners.

We are establishing alliances and consortiums to enhance cooperation with stakeholders across the GBA, aiming at advancing technology development, driving direct commercialisation of technology R&D, and developing industry standards and re-industrialisation roadmaps.

We are also organising events and conferences to help advance the industrial chain in the GBA. One such was the 2021 Advanced Semiconductor Innovation and Development Conference, which brought together nearly 2,400 industry participants from Hong Kong and the Mainland to discuss ways of fostering R&D collaborations in support of the national advancement of the semiconductor industry.

OUR TECHNOLOGY ROADMAP

ASTRI's R&D activities are organised across four Technology Divisions (TDs): Communications Technologies (CT); Integrated Circuits and Systems (ICS); IoT Sensing and AI Technologies (IOTSAI); and Trust and AI Technologies (TAIT).

These four Divisions deliver leading-edge, market-relevant applications in six areas: Smart City, Financial Technologies, Re-industrialisation and Intelligent Manufacturing, Digital Health, Application Specific Integrated Circuits (through our mandate as the Hong Kong branch of the Chinese National Engineering Research Centre (CNERC)), and Metaverse.

Smart City

In December 2020, the Hong Kong SAR Government updated its detailed blueprint for Smart City development. When fully realised, Hong Kong will be Asia's most technologically advanced 21st century city. ASTRI is supporting the government in its efforts to deliver this vision.

Smart City is one of ASTRI's core areas of expertise and focus. We are developing tools and platforms that will enable Smart City technologies to seamlessly communicate with one another, by fully utilising our 5G capabilities and increasing the functionality of our existing smart technologies.

Financial Technologies

The financial services landscape is changing due to the development of financial technologies, or FinTech. The Fintech Strategy 2025, launched by Hong Kong Monetary Authority (HKMA), encourages tech-driven innovation in the financial service sector.

As one of Hong Kong's strongest FinTech R&D groups, ASTRI is developing solutions by leveraging blockchain, strengthening cybersecurity and cryptography technology, improving analysis of big data, and providing valuable proofs-of-concept. We are supporting and spearheading the evolution of FinTech in Hong Kong from the perspective of ecosystem development, with a core industry focus on traditional and virtual banks, regulators and insurance companies.

Re-industrialisation and Intelligent Manufacturing

The Hong Kong Policy Address 2021 highlighted the importance of re-industrialisation through investment in infrastructure, talents, capital, technology and research. Hong Kong has the potential to unlock the Industry 4.0 vision by leveraging AI, robotics and data-centric solutions to make manufacturing more reliable and effective, and maintaining remote sites significantly easier.

Our Re-industrialisation and Intelligent Manufacturing team explores ways of making production processes faster, easier, and more efficient. ASTRI's work in Re-industrialisation and Intelligent Manufacturing technologies involves developing advanced platforms, tools, and solutions to create interconnected, fully digital smart factories. These are enabling businesses to streamline their operations, work more efficiently, and become more environmentally friendly.

Digital Health

ASTRI is committed to developing healthcare technology solutions that support the medical sector and benefit the community. With support from the Hong Kong SAR Government, we have made breakthroughs in fields such as biomedical imaging and medical data analytics and have provided medical professionals with new tools for treating patients and saving lives.

ASTRI's Digital Health team is applying R&D in ways that are increasing the efficiency of healthcare, enhancing and personalising medical services, and ultimately improving the quality of people's lives. We focus on developing new applications in areas such as elderly care, preventative health monitoring, medical diagnosis, and medical computing.

Application Specific Integrated Circuits

Integrated Circuits (IC) are key components of growth for many high-tech industrial sectors as they strive to significantly upgrade their capabilities, especially in telecommunications, smart city technology and electronics.

Our R&D initiatives in Application Specific Integrated Circuits arise from the mandate given to us in 2012 when the first-ever Hong Kong branch of the Chinese National Engineering Research Centre (CNERC) for Application Specific Integrated Circuit Systems was established at ASTRI, in collaboration with Southeast University (SEU) in Nanjing. The branch focuses on microelectronics and integrated circuits applied across various industries.

Metaverse

The metaverse represents the next milestone in the development of the Internet, and is now one of ASTRI's six core research areas, with both hardware and software development on the agenda.

As the Internet's next iteration, the metaverse offers various business opportunities to enterprises worldwide. ASTRI's experts are actively exploring the metaverse applications harnessing the power of digital twin, AR, VR, AI, virtual assets, etc., to unlock the true potential of this emerging arena. The key prospective use cases that our R&D focuses on include 3D mapping, vehicle inspection, remote maintenance, online education, virtual avatar, smart manufacturing, and more.

CHAIRMAN'S FOREWORD

IR. SUNNY LEE WAI-KWONG, BBS, JP
Chairman, Board of Directors

It is a great privilege for me to present ASTRI's Annual Report for the third time since being appointed as Chairman of the Board of Directors in 2019. These past two and a half years have been very special in my own professional journey. I am especially grateful to ASTRI colleagues for their total commitment and relentless pursuit of excellence, which have earned ASTRI its leadership reputation in the areas of 5G communications, FinTech, Re-industrialisation and Intelligent Manufacturing, Digital Health, and Application Specific Integrated Circuits.

Over the years, ASTRI has firmly and actively supported the Government's plan to develop Hong Kong into an international innovation and technology (I&T) hub. We are very proud of the fact that, since ASTRI's inception, we have had more than 1000 patents granted, have completed over 1000 R&D projects, and have transferred more than 1250 technologies to different industries.

Dr. Denis Yip took the helm of ASTRI in October 2021 as Chief Executive Officer, bringing extensive leadership experience from both the public and private sectors. He has brought new insights and new inspiration to ASTRI, pushing forward our strategy of constantly strengthening our research and commercialisation work and delivering world-class innovations that will enhance Hong Kong's competitiveness regionally and globally. I am confident that under Dr. Yip's leadership, ASTRI will continue to contribute significantly to the development of Hong Kong into a remarkable smart city, and will also seize the major opportunities brought by the National 14th Five-Year Plan, with its clear support for developing Hong Kong into a world-class I&T hub.

INNOVATION FOR THE DIGITAL ERA

In 2021, "the metaverse" became a worldwide buzzword. But it is much more than just a buzzword. The metaverse represents the next milestone in the development of the Internet. It offers the prospect of a seamless convergence of our physical and digital lives, by creating a unified virtual community where all can work, play, relax, transact and socialise, as well as to enhance the economic growth. As the largest applied R&D institution in Hong Kong, ASTRI is exploring innovative applications of the metaverse as another core initiative of its applied R&D activities.

The ASTRI team will be developing various metaverse-related technologies, including digital twin, AR, VR, and virtual asset applications, as well as cost-effective metaverse gadgets such as smart glasses. Our goal is to make these technologies available for use in all walks of life, leading to better work efficiency and quality of life for all, and significant enhancements to Hong Kong's overall competitiveness.

We will also be continuing our efforts to pursue innovative R&D for smart city development, in alignment with the Government's vision to transform Hong Kong into a smart and sustainable city. As a pioneer in next generation networks research, and one of the largest R&D facilities in Hong Kong dedicated to 5G testing and development, our work in this field is part of that technological transformation. To help businesses in Hong Kong capitalise on the benefits of 5G, ASTRI has developed a full set of solutions for the technology, including high-performance 5G core networks and pioneering O-RAN 5G base stations. One key application that 5G enables is C-V2X, which enhances road safety by enabling vehicles and road infrastructure to communicate with each other. With the support of the Innovation and Technology Commission and Transport Department, ASTRI has been promoting Smart Mobility through its C-V2X related projects. In 2021, we launched one of the world's largest C-V2X public road tests in Hong Kong to improve the city's mobility competence and take its road safety and efficiency to the next level.

The Fintech Strategy 2025, launched by Hong Kong Monetary Authority (HKMA), encourages tech-driven innovation in the financial services sector. With this in mind, ASTRI is collaborating with key players to deliver new technologies and solutions that will empower the financial services sector and accelerate digital transformation. For example, we have joined forces with tech-embracing companies to help MSMEs (Micro, Small and Medium Enterprises) get financing by leveraging AI's Federated Learning, all the while protecting their privacy and data security. We have also developed an AI-enabled ESG Report Analysis system which is helping investors by effectively identifying and sorting out the key points of corporate ESG reports.

The Government has prioritised re-industrialisation for the future, and is looking to have dedicated technology clusters pursuing innovative R&D in this area. This is one area in which ASTRI has strong core competency, with our expertise ranging from 5G networks to the Internet of Things, from Artificial Intelligence to Industrial Robots, from 3D and UHD video conversion to sophisticated power electronics. Its sophisticated

integrated device modules for manufacturing process, robot and environmental sensing are helping to create interconnected, fully digital smart factories, and enabling businesses to streamline their operations. The team's hard work over the years has borne plentiful fruit and been widely recognised. Many of our re-industrialisation innovations have gained prestigious awards from major organisations, including most recently the International Exhibition of Inventions of Geneva 2022, the Hong Kong Awards for Industries, the Hong Kong ICT Awards 2021, and more.

Another area where Hong Kong can drive and grasp new business opportunities is that of integrated circuits. ASTRI is engaged in a number of R&D projects in integrated circuits under the CNERC branch that we operate and has developed a number of advanced and innovative solutions in various areas including 3D integrated chip, the third-generation semiconductors, and AI and IoT chips. In November 2021, our electronic packaging innovation won a First-class Prize of the 2020 State Scientific and Technological Progress Award. This national-level award is the highest honour ever obtained by an R&D institution associated with the HKSAR Government in the field of electronic packaging. The award recognises ASTRI's success in developing high-density and high-reliability electronic packaging technology and promoting the development of China's electronics manufacturing industry.

INNOVATION BACKED BY TALENTS

ASTRI enjoys a dedicated and highly capable team of over 500 engineers and researchers. Their commitment and 'can-do' spirit have led to remarkable accomplishments in turning innovative R&D work into highly practical applications and technologies. At ASTRI, we aim to nurture the technology talents who come on board here, where they sharpen their skills and make important contributions. These same talents often go on to make even greater contributions elsewhere in the industry. The point is that building an innovation-led economy in Hong Kong is a collective effort. This is why we have established our "FinTech Future Leader Academy" which is cultivating I&T talents with our industry partners, and have launched our first-of-a-kind "Top Technology Scholar Programme" offering a promotion plan and scholarships to attract advanced degree holders.

At ASTRI, we will continue to forge and strengthen our partnerships with other players in Hong Kong's I&T ecosystem, and leverage their strengths to source, nurture and promote the best talents. In turn, we will help other players in the ecosystem to draw on ASTRI's spectrum of research capabilities as a way of enhancing their own development pipelines.

OPPORTUNITIES IN THE GREATER BAY AREA (GBA)

Our Nation's 14th Five-Year Plan lays out, for the first time, support for Hong Kong's development into an international I&T hub and regional intellectual property trading centre. Meanwhile, the HKSAR Government has announced an unprecedented package of support measures aimed at developing the city's I&T ecosystem, including measures to attract and nurture talents, to increase the share of R&D expenditure in the GDP, to lift investment in artificial intelligence, robotics and healthcare technologies, and to promote FinTech. In short, there has never been a better time to be involved in I&T development in Hong Kong!

In alignment with the Government's I&T agenda, at ASTRI we are developing new R&D strategies and setting new directions relevant to the needs of the nation and its industries. Since taking up the post of ASTRI CEO in October last year, Dr. Yip has been working closely with his team to formulate plans and start preparing for ASTRI to expand its I&T footprint in the GBA. New development strategies include plans for ASTRI to undertake more R&D projects in the GBA, cooperate with local universities and research institutes, attract and cultivate local I&T talents, and expand its R&D resources in the GBA.

Hong Kong's output in technologies will enjoy easy market access to the GBA, Greater China, and even internationally, provided that we take full advantage of Hong Kong's strategic advantages. These include its geographical location, its IP regime, its rule of law, its commitment to open data and information, and its global outlook.

We intend to continue to build deep capabilities in areas such as Smart City and Re-industrialisation, FinTech and the metaverse. We will use these capabilities to tackle a wide spectrum of national needs, and to contribute to building our local R&D ecosystem's competitive advantage over the longer term. ASTRI will be a central part of the next stage of Hong Kong's evolution, helping our city to soar to greater technological heights than ever before.

IR. SUNNY LEE WAI-KWONG, BBS, JP
Chairman, Board of Directors

CHIEF EXECUTIVE OFFICER'S REPORT

DR. DENIS YIP SHING-FAI
Chief Executive Officer

In this time of tremendous global challenges and changes, new and innovative technology applications have become exceptionally important for our society. Recognising this, ASTRI has committed itself to forging ahead with technological advances and fostering innovative thinking. Our ultimate goal is to help Hong Kong develop into a world-class smart city where technological innovations are integral parts of everyday life.

Since taking up the role of Chief Executive Officer of ASTRI in October 2021, it has been my proud responsibility to promote the development of applied scientific research and contribute to Hong Kong's scientific research ecosystem. Having worked in Mainland China, Asia, and the US among other places throughout the years, I am delighted to be back at last in Hong Kong, a place that is very close to my heart. Working here alongside hundreds of research professionals from Hong Kong, Mainland China and overseas, all striving to help build a better Hong Kong, I have been struck by the talent and dedication in this city, the power of ambition and the creative application of knowledge to make a real difference.

ASTRI is firmly committed to playing a leading role in reinvigorating Hong Kong's entire scientific research ecosystem. To do this, we have collaborated widely with government, corporations and universities, bringing together our respective unique strengths and pooling our talents, technologies, capital and other resources. These collaborations have led to strong and mutually

supportive relationships, ultimately contributing to the common goal of sustainable development. In 2022, we will sign a memorandum of understanding with ACCESS, Asia's first transnational and interdisciplinary R&D centre for AI chip design, a joint initiative of the Hong Kong University of Science and Technology, the University of Hong Kong, the Chinese University of Hong Kong and Stanford University. This cooperative programme, facilitated by InnoHK, aims at further promoting local smart chip development and achieving world-leading standards of excellence here. ASTRI is also planning to implement an R&D programme in 2022 through two laboratories under ACCESS, which will further push the boundaries of innovative research.

In addition, another of ASTRI's missions is to promote the industrialisation of technologies, to accelerate the development of smart manufacturing, and to develop new technologies suitable for commercialisation. Effective technology transfer means we can also help to enhance industry productivity and professionalism. In the 2021-22 year, our four Technology Divisions launched 42 research projects and transferred 70 technologies to different industries, generating an income of HK$116.25 million. At the same time, ASTRI obtained 59 new patents in China, the US and other countries, laying a solid foundation for us to pursue further research and development initiatives and introduce more innovative technologies in Hong Kong in support of technology industrialisation and smart manufacturing.

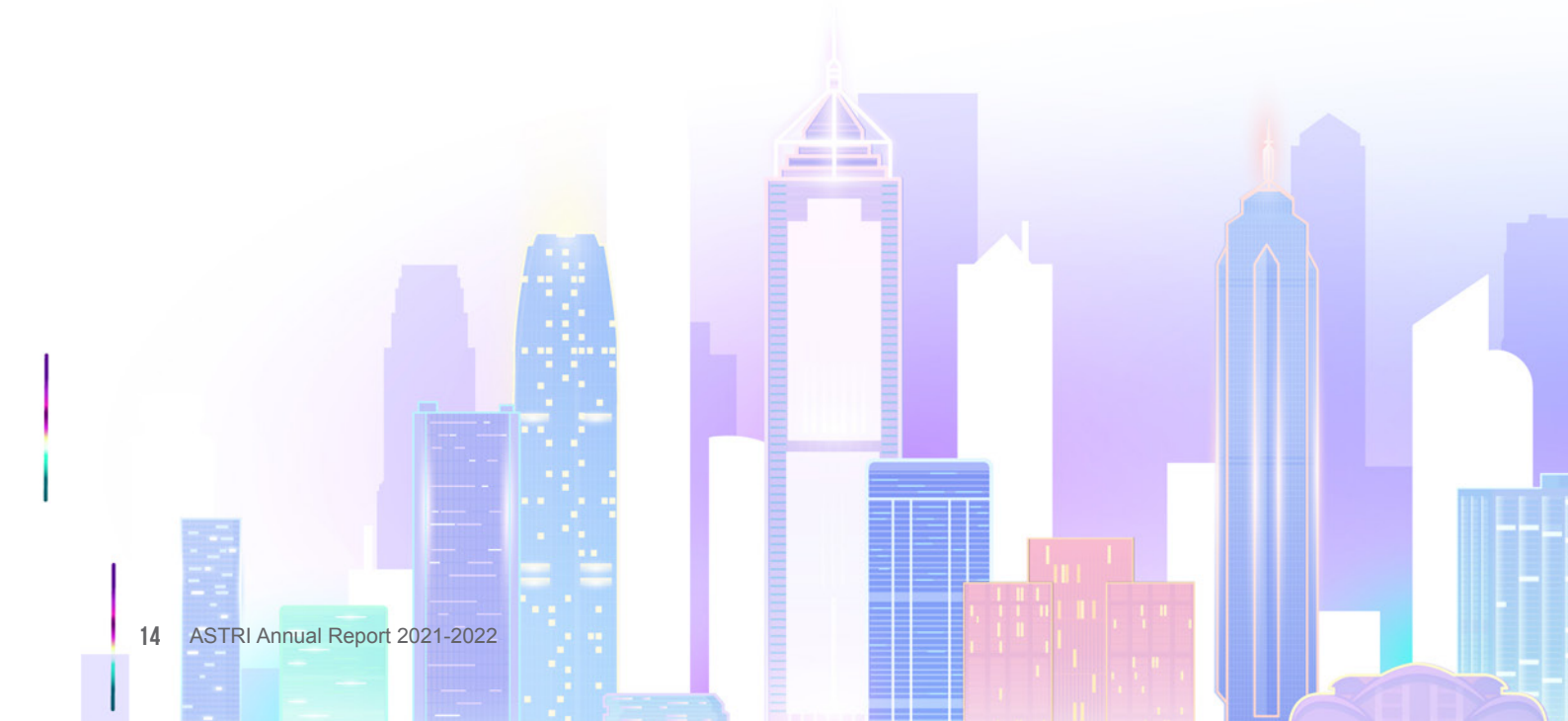
The global pandemic made 2021 a very challenging year, but we remained unflagging in our R&D efforts on a wide range of projects. One example was a project undertaken with a local financial institution involving the integration of augmented reality (AR) and AI technologies, which has now entered its second phase and is creating a novel business model for the corporate community. For this project, ASTRI is exploring new industry use cases adopting integrated AI-AR solutions that bring together "intelligence" and "innovation". The project is helping local corporate clients embrace a new era of smart development.

ASTRI has been keeping pace with the times over the past 22 years, and our continued efforts in seeking breakthroughs have been recognised worldwide. Since 2018, ASTRI has garnered 70 awards at the International Exhibition of Inventions of Geneva, including two gold and ten silver awards this year. One of our gold-award winning projects, "Making Future Cities and Campuses Smarter and More Efficient with 5G", is an example of ASTRI's leading role in communications technology; also known as the "Easy 5G Solution", the project involves pioneering work relating to 5G base stations, 5G MEC (Multi-access Edge Computing) and 5G core networks. It is providing Hong Kong with its first 5G end-to-end network infrastructure solution, and laying a vital foundation for the development of autonomous transportation systems.

During the year, ASTRI also won the Equipment and Machinery Design Award in the 2021-22 Hong Kong Awards for Industries for our "End-to-end AI-Powered Visual Inspection Platform for Quality Control". Leveraging deep learning and machine vision technology, this platform significantly improves the quality control process by improving efficiency in the training of computers to perform quality inspections. The platform reduces the number of inspection staff needed by 80%, makes the inspection speed 20 times faster, and reduces the “missing rate” by 25%.

As Hong Kong’s most well-established applied science and technology research institute, ASTRI is in a strong position to support the government’s technological development policies. This includes support for re-industrialisation through innovation, as outlined in the Chief Executive’s 2021 Policy Address, the Hong Kong Monetary Authority’s “FinTech 2025” strategy, and the Innovation and Technology Bureau’s “Hong Kong Smart City Blueprint 2.0”. To enhance our support work, ASTRI has been expanding and accelerating the development of its Technology Divisions, focusing specifically upon six key areas: Re-industrialisation and Intelligent Manufacturing, Application-specific Integrated Circuits, Financial Technologies, Smart City, Digital Health and the Metaverse. Our ultimate objective is to enhance Hong Kong's competitiveness and support its transformation into an international innovation and technology hub, in line with the government’s long-term vision.

Looking ahead, further collaboration and integration with the GBA will be a core element of our future growth. As a vital pillar supporting Hong Kong's development into an international innovation and technology hub, ASTRI has long planned to expand its operations into the GBA. We already established a new office in Nanshan, Shenzhen; in April we signed a memorandum of understanding with the Southern University of Science and Technology, with the plan to establish a joint laboratory within the next five years, primarily for research in advanced semiconductors, next-generation communications and other technologies, and their applications. This is ASTRI’s first collaboration with a university in the GBA, and marks the beginning of more comprehensive cross-border R&D collaborations in the near future.



Plans are also underway to establish a new GBA headquarter for ASTRI at the Hong Kong Science Park Shenzhen Branch in Futian, with the new office scheduled for commissioning next year. This will provide us with a base for exploring new opportunities for joint development across different cities in the GBA. ASTRI acts as a vital bridge connecting academia pursuing ICT research with industries seeking ICT applications. As such, we have an important role to play in strengthening coordination and expanding collaboration within the GBA's ICT ecosystem in order to enhance the quality of research and development there. I believe our efforts will create unique advantages for the GBA's scientific research ecosystem, and equip ourselves for future challenges.

DR. DENIS YIP SHING-FAI
Chief Executive Officer

BOARD OF DIRECTORS

COMPOSITION OF THE BOARD

As of 31 March 2022, ASTRI's Board was made up of the Chairman and 19 members, two of whom were official members.

CHAIRMAN

IR. SUNNY LEE WAI-KWONG, BBS, JP

Vice-President (Administration),
City University of Hong Kong

OFFICIAL MEMBERS

MS. ANNIE CHOI SUK-HAN, JP

Permanent Secretary for Innovation and Technology, Innovation and Technology Bureau

MS. REBECCA PUN TING-TING, JP

Commissioner for Innovation and Technology, Innovation and Technology Commission

MEMBERS (IN ALPHABETICAL ORDER OF SURNAME)

PROF. CHAN CHUN-KWONG

Programme Director, MSc in Financial Technology, Faculty of Engineering,

Professor of Practice in FinTech,

Department of Systems Engineering and Engineering Management,

The Chinese University of Hong Kong

PROF. CHRISTOPHER CHAO YU-HANG

Vice President (Research and Innovation),

Chair Professor of Thermal and Environmental Engineering,

Department of Building Environment and Energy Engineering and Department of Mechanical Engineering,

The Hong Kong Polytechnic University

MEMBERS (IN ALPHABETICAL ORDER OF SURNAME)

MR. STEPHEN CHAU KAM-KUN

Executive Director & Chief Technology Officer, SmarTone Telecommunications Holdings Limited

MR. CHARLES CHOW SAI-KEUNG

South China & Hong Kong Assurance Leader, PricewaterhouseCoopers

MR. STEVE CHUANG TZU-HSIUNG

Chairman and Chief Executive Officer, ProVista Group

MR. STEPHEN HO WAI-CHUNG

Founder and CEO, n-hop technologies Limited

PROF. LAM TAK-WAH

Head, Department of Computer Science, The University of Hong Kong

MR. EDMUND LEE CHI-WAI

Chief Executive Officer, Application Technology Company Limited

MEMBERS (IN ALPHABETICAL ORDER OF SURNAME)

PROF. SABRINA LIN MAN-YEE

Senior Advisor to the President, Office of the President, The Hong Kong University of Science and Technology

MR. THEODORE MA HENG

Managing Partner, CoCoon Ignite Ventures

MR. PETER NG HON-YU

Vice President, Technology, Enabling Technology Group, ASM Pacific Technology Ltd.

IR. PROF. JOSEPH NG KEE-YIN

Professor, Department of Computer Science, Hong Kong Baptist University

DR. ALFRED NG MAN-CHEUK

Chief Technology Officer, Suga International Holdings Limited

IR. DR. SAMSON TAI KIN-HON

Professor of Practice, School of Business, Hong Kong Baptist University

MR. ANTHONY TONG TAT-HAY

Managing Partner, Robin Bridge & John Liu

MR. WILFRED WONG KAM-PUI, BBS, JP

Managing Director, RESOLUTIONS HR & Business Consultancy Co. Ltd.

MS. ADA WONG YIN-MAN

Executive Director, Wong's International Holdings Limited

BOARD FUNCTIONAL COMMITTEES

Three functional committees assist the Board in its oversight of ASTRI: the Finance and Administration Committee oversees ASTRI's financial and administrative arrangements; the Technology Committee oversees ASTRI's R&D initiatives; and the Audit Committee ensures that internal and external audit processes are properly carried out.

The members of the committees as of 31 March 2022 were as below:

FINANCE AND ADMINISTRATION COMMITTEE (FAC)	TECHNOLOGY COMMITTEE (TC)	AUDIT COMMITTEE (AC)
Prof. Chan Chun-kwong (Chairman)	Mr. Stephen Ho Wai-chung (Chairman)	Mr. Charles Chow Sai-keung (Chairman)
Ms. Rebecca Pun Ting-ting, JP	Ms. Rebecca Pun Ting-ting, JP	Ms. Rebecca Pun Ting-ting, JP
Mr. Stephen Chau Kam-kun	Prof. Christopher Chao Yu-hang	Prof. Chan Chun-kwong
Prof. Sabrina Lin Man-yee	Mr. Steve Chuang Tzu-hsiung	Mr. Edmund Lee Chi-wai
Mr. Theodore Ma Heng	Prof. Lam Tak-wah	Dr. Alfred Ng Man-cheuk
Mr. Anthony Tong Tat-hay	Mr. Edmund Lee Chi-wai	Ir. Dr. Samson Tai Kin-hon
Mr. Wilfred Wong Kam-pui, BBS, JP	Ir. Sunny Lee Wai-kwong, BBS, JP	Ms. Ada Wong Yin-man
	Mr. Theodore Ma Heng	
	Mr. Peter Ng Hon-yu	
	Ir. Prof. Joseph Ng Kee-yin	
	Dr. Alfred Ng Man-cheuk	

CHANGES IN BOARD DIRECTORS

NEW DIRECTORS	DATE OF APPOINTMENT
Prof. Christopher Chao Yu-hang	21 October 2021
Mr. Wilfred Wong Kam-pui, BBS, JP	21 October 2021

RETIRED DIRECTORS	DATE OF RETIREMENT
Mr. Ha Yung-kuen, BBS	21 October 2021
Mr. Andy Liu An-ting	21 October 2021

ATTENDANCE AT MEETINGS

A total of four Board meetings were convened during the 2021-22 year. The attendance records of members at Board meetings and meetings of the Board Functional Committees held between 1 April 2021 and 31 March 2022 are as follows:

BOARD MEETINGS

	30 JUN 2021	29 SEP 2021	16 DEC 2021	31 MAR 2022
Total number of directors during the period	20	20	20	20
Total number of directors present at meeting	18	18	19	19
Total number of apologies	2	2	1	1
Percentage in attendance	90%	90%	95%	95%

FAC MEETINGS

	21 MAY 2021	20 AUG 2021	19 NOV 2021	24 FEB 2022
Total number of FAC members during the period	8	8	7	7
Total number of FAC members present at meeting	8	7	7	6
Total number of apologies	0	1	0	1
Percentage in attendance	100%	88%	100%	86%

TC MEETINGS

	4 JUN 2021	3 SEP 2021	24 NOV 2021	11 MAR 2022
Total number of TC members during the period	11	11	9	11
Total number of TC members present at meeting	9	9	8	10
Total number of apologies	2	2	1	1
Percentage in attendance	82%	82%	89%	91%

AC MEETINGS

	27 MAY 2021	26 AUG 2021	16 SEP 2021 (SPECIAL MEETING)	11 NOV 2021	3 MAR 2022
Total number of AC Members during the period	7	7	7	7	7
Total number of AC Members present at meeting	5	7	4	5	5
Total number of apologies	2	0	3	2	2
Percentage in attendance	71%	100%	57%	71%	71%

OUR ORGANISATION

ASTRI operates under the auspices of the Hong Kong SAR Government's Innovation and Technology Commission (ITC). ASTRI is led by a Chief Executive Officer (CEO), accountable to the Board of Directors and responsible for all matters relating to the overall management of the organisation. The CEO is assisted by a senior management team of C-Officers, responsible for R&D, operations, finance, marketing, administration and other supporting functions, and the Technology Division Heads, who lead ASTRI's four R&D teams and are overseen by the Chief Technology Officer.

C-OFFICERS

In 2021-22, the following C-Officers were members of the Senior Management team:

DR. DENIS YIP*
Chief Executive Officer

DR. LUCAS HUI
Chief Technology Officer

DR. MARTIN SZETO
Chief Operating Officer

MS. CAMMY YUNG
Chief Financial Officer

MR. AARON HO
Chief Administrative Officer

*Dr. Denis Yip took up office as CEO on 5 October 2021.

TECHNOLOGY DIVISION HEADS

ASTRI's four Technology Divisions are responsible for the development of their respective technologies. Each is headed by an experienced leader in the field. The Division Heads in 2021-22 were as follows:

DR. LUCAS HUI
Chief Technology Officer

DR. JUSTIN CHUANG
Vice President, Communications Technologies (CT)

MR. ALAN CHEUNG
Senior Director, Trust and AI Technologies (TAIT)

DR. DANIEL SHI
Senior Director, Integrated Circuits and Systems (ICS)

DR. TSAI CHEN JUNG
Senior Director, IoT Sensing and AI Technologies (IOTSAI)

ANNUAL REMUNERATION OF STAFF IN THE ORGANISATION'S TOP THREE TIERS

POST	ANNUAL REMUNERATION# 1 APR 2021 – 31 MAR 2022 (HK$)
First tier Chief Executive Officer	$1,733,990^
Second tier Five senior executives	$10,540,380
Third tier Seven functional leaders/ senior technology experts	$12,703,460

ANNUAL REMUNERATION# (HK$)	NUMBER OF STAFF IN THE TOP THREE TIERS
1,000,000 or below	2
1,000,001 to 1,500,000	0
1,500,001 to 2,000,000	6
2,000,001 to 2,500,000	2
2,500,001 to 3,000,000	2
3,000,001 to 3,500,000	1

The information covers actual remuneration (including base salary, salary adjustment, acting allowance, performance-linked pay, special R&D allowance, variable payment and cash award (Inventor Award)) for 2021-2022 received by staff at the top three tiers who were in service as of 31 March 2022. It also covers the actual remuneration of –

- staff appointed during the financial year – New Chief Executive Officer joined on 5 October 2021^ and 1 new Senior Director joined on 1 December 2021; and
- staff departed during the financial year – Chief Marketing Officer departed on 8 May 2021 and Chief Technologist, Communications departed on 29 December 2021.

The figures have been rounded to the nearest HK$10.

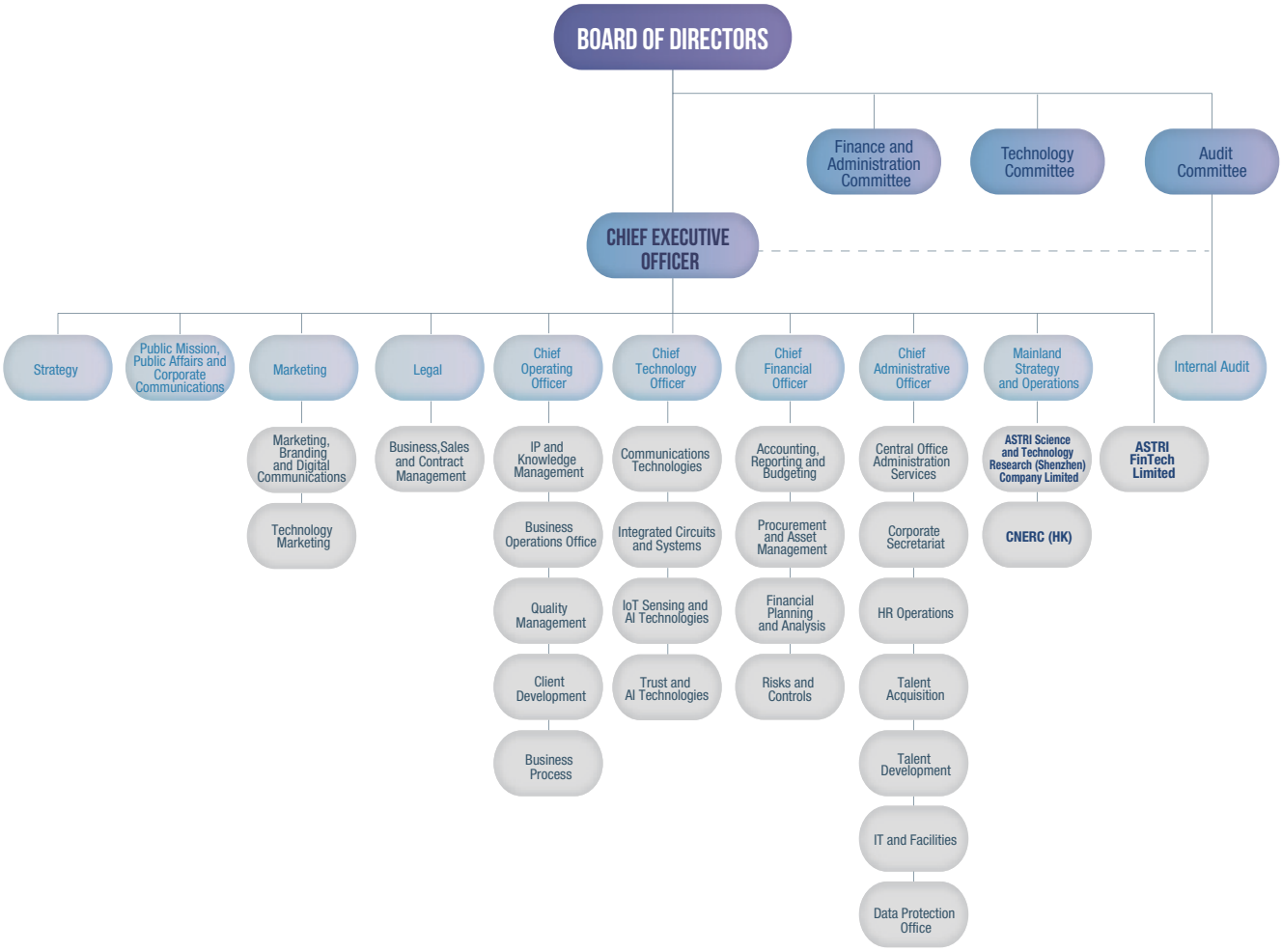
OUR PEOPLE

As of 31 March 2022, ASTRI consisted of a team of 527 dedicated and highly competent individuals, all working towards the common goal of creating a better future for Hong Kong and the nation.

Our R&D teams (excluding interns), organised into four Technology Divisions, make up 70% of the total workforce. The remaining 30% is made up of personnel providing various support services and functions.

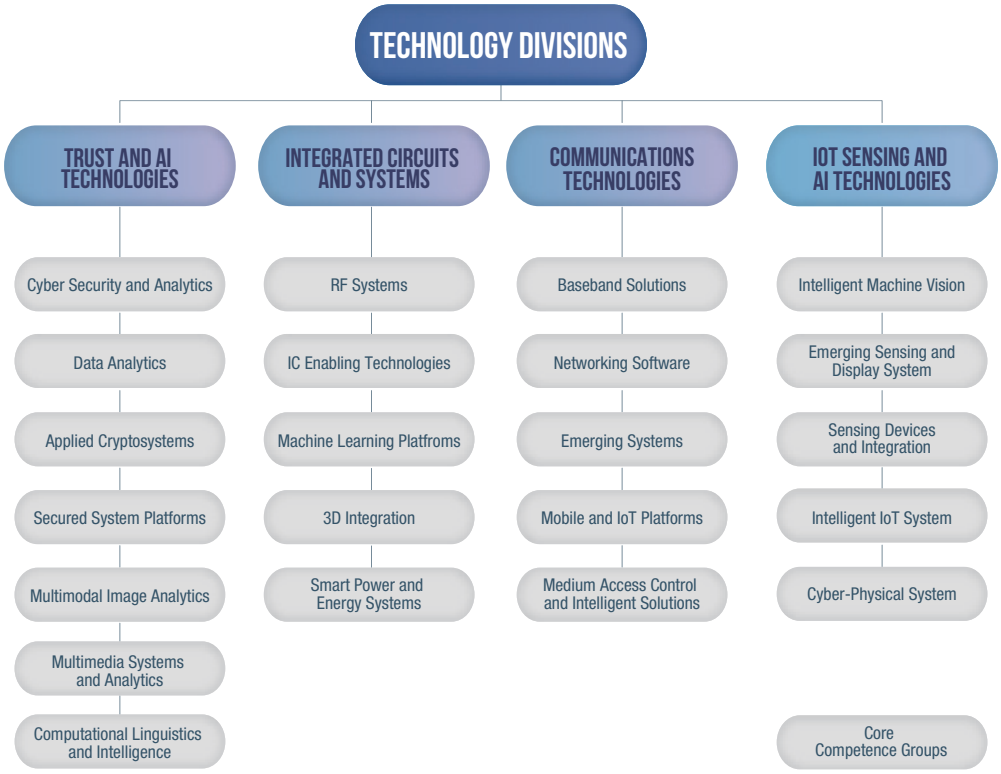
ASTRI's organisational structure as of 31 March 2022 is laid out in the chart below:

ASTRI'S ORGANISATIONAL STRUCTURE

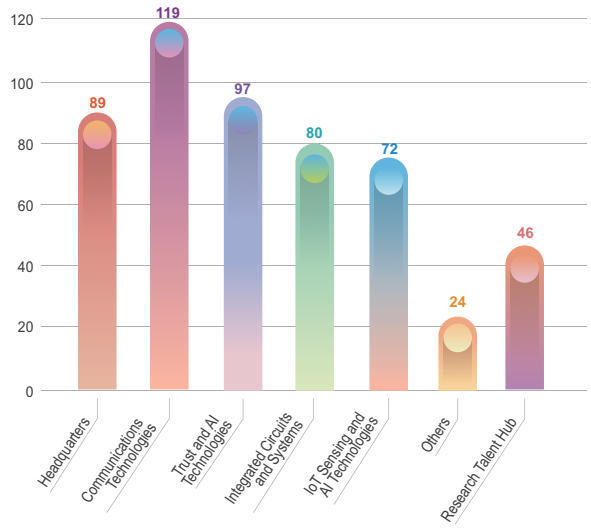


* Major Incident Group (MIG) comprises of the CEO, COO and CAO, the MIG was formed on 13 November 2019. The group is responsible for the formulation of business continuity strategies and enterprise-wide decision-making in response to emergency situations.

ASTRI'S R&D ORGANISATIONAL STRUCTURE

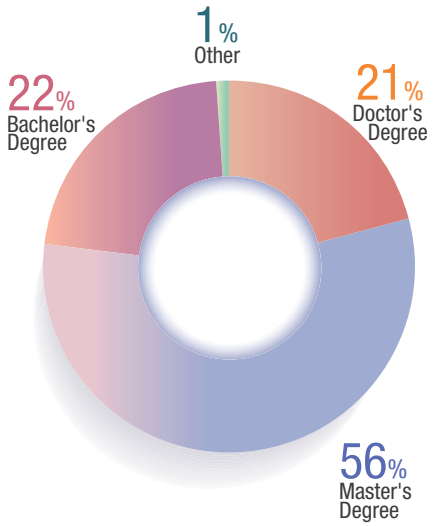


EMPLOYEE NUMBERS BY FUNCTIONAL AREA



Total:527

ACADEMIC QUALIFICATIONS OF R&D STAFF AS OF 31 MARCH 2022



GOVERNANCE AND CONTROL

As a publicly funded R&D centre, ASTRI is committed to upholding the highest standards of corporate governance. In line with our mission, we work in the interests of our stakeholders and the taxpayers of Hong Kong.

ASTRI's corporate governance policies and principles are clearly laid out in its Corporate Governance Manual. The Manual guides the efforts of the Board and Senior Management to ensure that ASTRI always operates in a transparent and accountable manner. It includes comprehensive guidelines on:

- ORGANISATION AND MANAGEMENT STRUCTURE
- HR POLICIES AND STAFF CONDUCT
- FINANCIAL MANAGEMENT AND CONTROLS
- INTERNAL CONTROLS AND EXTERNAL REPORTING
- RISK MANAGEMENT

The Manual is updated periodically to incorporate any developments needed to improve ASTRI's operations, and to reflect the changing business environment.

INTERNAL AUDIT

ASTRI's Internal Audit Department (IAD) was set up in 2003 under the Audit Committee (AC). Via the AC, the IAD assists the Board on corporate governance matters by providing it with information about and assurance regarding ASTRI's internal controls.

The Internal Audit Charter, endorsed by the AC, affirms the IAD's independence, sets out its responsibilities, and defines the scope of its authority.

The IAD conducts internal audit reviews in accordance with a 3-year risk-based rolling plan as approved annually by the AC. In these reviews, the IAD assesses the adequacy and effectiveness of ASTRI's internal control processes and procedures, as well as compliance with them.

During the reporting year, the IAD conducted internal audit reviews on various areas of ASTRI's operations. These included cybersecurity, project management, conflict of interest management, expenditure on marketing and communications, post-project commercialisation income, entertainment, and duty travel. Significant controls are mostly in place in these areas, while a number of enhancement opportunities were identified. During the reporting year, the IAD submitted two half-yearly reports on the abovementioned reviews to the AC, together with its recommendations. The IAD periodically follows up the implementation status of the recommendations it makes.

COMPLIANCE

The Head of Internal Audit has been appointed by the Board as the Compliance Officer since April 2007. The Compliance Officer's role is to assist the Board, via the AC, with compliance matters relating to internal and external procedures and regulations. The Compliance Officer receives reports from departmental compliance officers and submits quarterly compliance reports to the AC.

SAFEGUARDS AGAINST CONFLICTS OF INTEREST

ASTRI has comprehensive internal controls that safeguard against conflicts of interest. The Code of Conduct is regularly reviewed and updated as necessary to ensure that potential conflicts are always declared and adequately managed. All ASTRI employees are required to make an annual declaration to confirm that they have read, understood and are compliant with the Code.

WORKPLACE POLICY

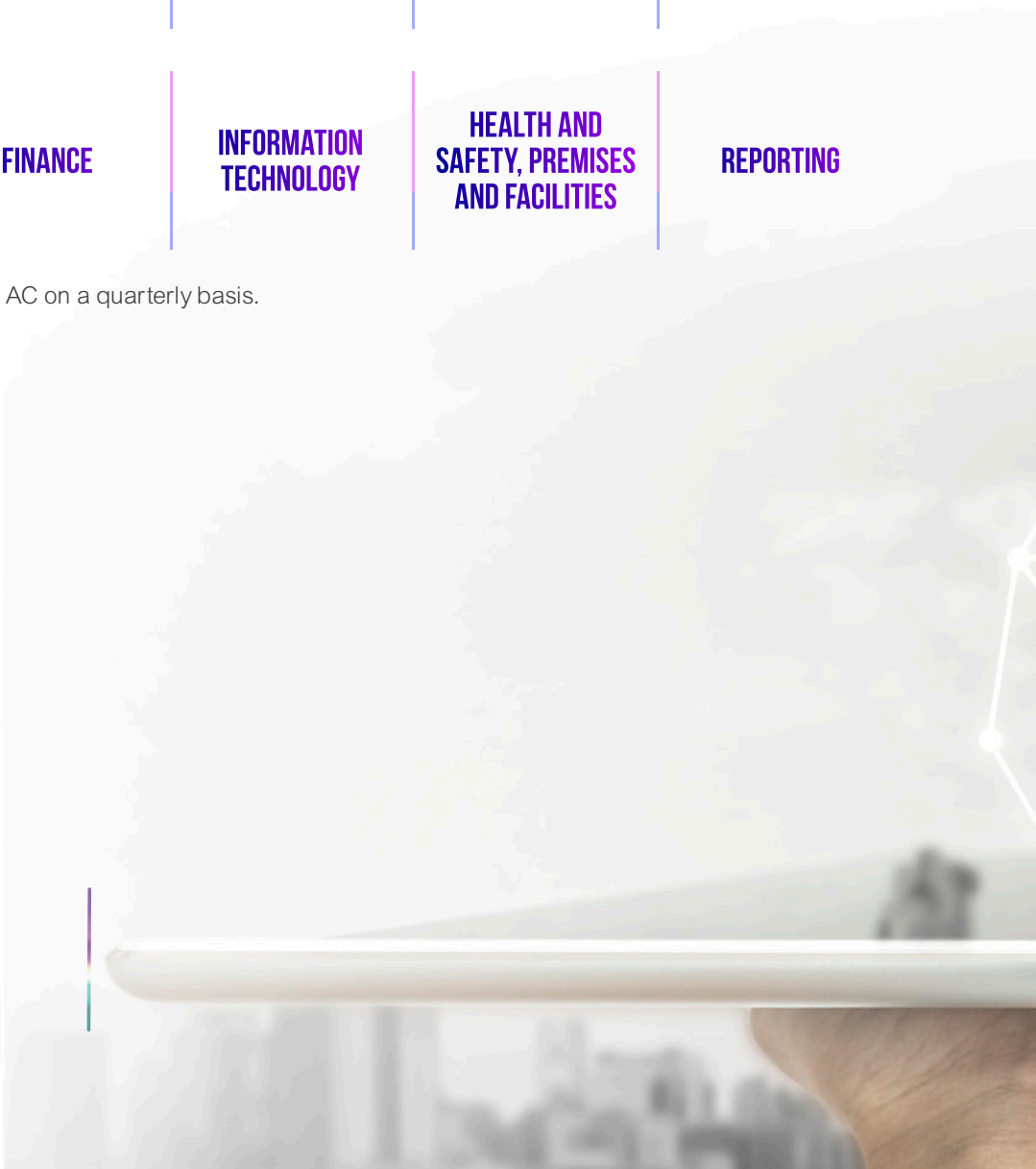
ASTRI has zero tolerance for discrimination and harassment. We organise regular seminars on relevant policies and regulations, with the aim of promoting equal opportunities and preventing discrimination and harassment in the workplace.

RISK MANAGEMENT

ASTRI has a Risk Management (RM) process to identify, evaluate and mitigate risks. The process is governed by an RM Policy and is facilitated by the IAD. The RM Policy sets out the roles and responsibilities of different parties, and provides an overview of the RM process. A Risk Register is maintained to keep track of various risks identified, covering the following broad thematic categories:

STRATEGY AND PARTNERSHIP	CORPORATE GOVERNANCE AND ETHICS	COMPLIANCE	CORPORATE COMMUNICATIONS AND RELATIONS	RESEARCH AND DEVELOPMENT
HUMAN RESOURCES	FINANCE	INFORMATION TECHNOLOGY	HEALTH AND SAFETY, PREMISES AND FACILITIES	REPORTING

Risk updates are reported to the AC on a quarterly basis.



QUALITY MANAGEMENT SYSTEM

Quality is paramount for all of ASTRI's research deliverables. To this end, ASTRI has adopted the ISO 9001 Quality Management standard, which helps us deliver consistently high-quality research to our clients and partners. In June 2021, international quality assurance body Bureau Veritas Certification conducted an ISO 9001 surveillance audit on ASTRI's operations. The audit certified that ASTRI's operations were fully compliant with the standards, with zero non-conformance.

INFORMATION SECURITY MANAGEMENT SYSTEM

ASTRI has adopted the ISO 27001 Information Security Management standard for its R&D activities in Financial Technologies (FinTech) in order to safeguard the confidentiality, integrity and availability of information. Adoption of the standard helps mitigate cybersecurity risks and improve our cyber-defence capabilities. Our FinTech R&D professionals regularly attend information security awareness training sessions to learn about the latest and most advanced tools for mitigating cybersecurity risks.

An external consultancy company performs vulnerability assessment and penetration tests on ASTRI's Information Technology infrastructure and network equipment every year to ensure our security controls remain effective. In October 2021, the certification body, SGS Hong Kong Limited, conducted an ISO 27001 certification audit of ASTRI's operations and found no non-conformance. ASTRI is continuing to improve and strengthen its data, information and operations security, staying abreast of the latest technologies to combat cybersecurity risks.

ACHIEVEMENTS
AWARDS AND RECOGNITIONS

ASTRI CLINCHES 12 MEDALS AT WORLD'S LARGEST INNOVATION EXPO

ASTRI won twelve medals (two gold and ten silver medals) at the International Exhibition of Inventions of Geneva 2022.

One of the gold medals was awarded for ASTRI's "Making future cities and campuses smarter and more efficient with 5G" solution, commonly known as the "Easy 5G Solution". This is Hong Kong's first end-to-end 5G network solution incorporating world-leading 5G base station, 5G MEC (Multi-access Edge Computing) and 5G Core technologies. Its flexible design, easy deployment and relatively low cost is lowering the entry barriers for small and medium enterprises wanting to enter the 5G market, and is supporting the rapid roll-out of 5G applications in Hong Kong. ASTRI has licensed the use of its Easy 5G Solution to around 20 local and mainland corporations, including a number of telecommunications service providers.

ASTRI's "Novel underwater wireless power charging solution against climate change" was another gold medal-winner at the exhibition, for its contribution to alleviating the impact of climate change on our oceans. For this solution, major breakthroughs in the 3rd generation semiconductor, power converter and wireless power transfer system enabled ASTRI to extend the working range and operation time of unmanned vehicles engaged in underwater and offshore activities.

The full list of awards won by ASTRI this year is as follows:

GOLD MEDALS	
Making future cities and campuses smarter and more efficient with 5G	Novel underwater wireless power charging solution against climate change

SILVER MEDALS	
The generation of knowledgeable chatbot	Low carbon emission design optimisation for AI computing
Mass real-time data stream processing for digital marketing	Give batteries a second life
Building blocks for future digitisation of paper documents	Rapid charging technology for reducing downtime and increasing productivity for mobile robotics
Evolution of cross-boundary compliance ecosystems in pandemics	Low-cost AI night vision technology for life saving
Enhancing future smart mobility infrastructure with low latency, high precision and reliable C-V2X system	Popularizing preventive eye retina checking solution

ASTRI's Electronic Packaging Innovation awarded First-class Prize of the 2020 State Scientific and Technological Progress Award

A R&D project in which ASTRI played an important part, titled "Key Technology and Complete Set of Processes for High Density and High Reliability Electronic Packaging", won a First-class Prize of the 2020 State Scientific and Technological Progress Award. This national-level award represents the highest honour ever obtained by an R&D institution associated with the Hong Kong SAR Government in the field of electronic packaging. It was presented at the 2020 State Science and Technology Awards Conference, held in the Great Hall of the People in Beijing on 3 November 2021.

ASTRI and HKT scoop 2021 Communications Association of Hong Kong STAR Award

ASTRI and Hong Kong Telecom (HKT) were jointly awarded the 2021 Communications Association of Hong Kong (CAHK) STAR Award "Best 5G Application" Bronze Award for their jointly developed cellular vehicle-to-everything (C-V2X) solution. ASTRI launched a 14km public road test of its C-V2X solution in Shatin in March 2021, leveraging HKT's 5G technologies which enable ultra-low latency transmissions of real-time traffic information. The C-VX2 solution is laying an important foundation for Smart Mobility, while enhancing road safety and traffic efficiency.

ASTRI wins four awards at Hong Kong Awards for Industries

ASTRI garnered four awards at the 2021-22 Hong Kong Awards for Industries (HKAI). The accolades were for its highly efficient quality control platform, its camera system for enhancing safety at construction sites, its world-leading 5G network solution, and its energy-efficient direct current technology.

The award-winning solutions include

- **Equipment and Machinery Design - Design Award: End-to-End AI-Powered Visual Inspection Platform for Quality Control**
- **Equipment and Machinery Design - Certificate of Merit: NEXCAM 360**
- **Technological Achievement - Certificate of Merit: Easy 5G**
- **Innovation and Creativity - Certificate of Merit: Energy-efficient Direct Current Power Supply Solution for Carbon Neutral Buildings**

ASTRI garners two awards for its smart solutions at Hong Kong ICT Awards 2021

ASTRI won a Smart Living (Smart Home) Silver Award for its Power Supply System for Carbon Neutral Buildings at the Hong Kong Information and Communications Technology Awards (ICT Awards) 2021. It also won a Smart People (Smart Education and Learning) Certificate of Merit with education technology firm Bridge AI Ltd. for a jointly-developed Integrated Intelligent Intervention (3i)-Learning System.

ASTRI wins Best Innovative Technology Application Case Award and Best Booth Design at PT Expo China 2021 for its Cellular Vehicle-to-Everything (C-V2X) solution

ASTRI's C-V2X on Road Safety and Efficiency Solution was named the Best Innovative Technology Application Case at the ICT China High Level Forum (the Forum) hosted by the China Association of Communication Enterprises. In addition, ASTRI's booth also won the Best Booth Design Award. The Forum was held at the PT Expo China 2021, the ICT ecosystem's leading annual event organised by the Ministry of Industry and Information Technology of China.

ICT China High Level Forum fostered fundamental research into ICT applications, with a focus on critical, cutting-edge and disruptive technological innovations that support the development of China's manufacturing, internet and network, and digital capabilities.

ASTRI recognised as Best Cross-border Platform on Commercialisation of Innovation and Technology in Innovation China's 100 Global Best Practices for Technology Transfer 2021

ASTRI was named the Best Cross-border Platform on Commercialisation of Innovation and Technology in Innovation China's 100 Global Best Practices for Technology Transfer 2021 at the 2021 China International Technology Trade Forum. ASTRI serves as an innovation platform to carry out the research and development of core technologies and products for the GBA market. This award recognises ASTRI's important role in facilitating the cross-border transfer of local R&D and innovative technologies. The R&D results that ASTRI has commercialised include the 5G Core, 5G O-RAN base station, C-V2X, DataHOUSE™ AR Remote Hand for maintenance operation, the 3rd Generation Semiconductor technology, Direct Current technology, Narrowband Internet of Things (NB-IoT) chips, and Cervical Cancer Screening Management System.

ACHIEVEMENTS

COMMERCIALISATION TO ENHANCE SMART CITY DEVELOPMENT

ASTRI'S ROLE IN SMART CITY DEVELOPMENT

The HKSAR Government aims to make Hong Kong into a world class Smart City, utilising innovation and technology (I&T) breakthroughs for a stronger economy and a higher quality of living. In December 2017, the Government published a Smart City Blueprint for Hong Kong[1], setting out 76 initiatives under six smart areas: Smart Mobility, Smart Living, Smart Environment, Smart People, Smart Government, and Smart Economy. Through its extensive I&T research and commercialisation initiatives, ASTRI is playing a crucial role in helping Hong Kong become a world-leading Smart City. ASTRI's six core R&D areas are all ones in which technology can be transferred to industry to push forward Smart City development. Here are some of the key areas where we have been making a difference.

SMART ECONOMY: FINTECH FOR THE FUTURE

In 2021 the Hong Kong Monetary Authority unveiled its "FinTech 2025[2]" strategy, a comprehensive blueprint for the banking sector to embrace financial technology by 2025. ASTRI is supporting FinTech 2025 especially through ecosystem development, with a core industry focus on traditional and virtual banks, regulators and insurance companies. ASTRI's FinTech ecosystem and commercialisation solutions include:

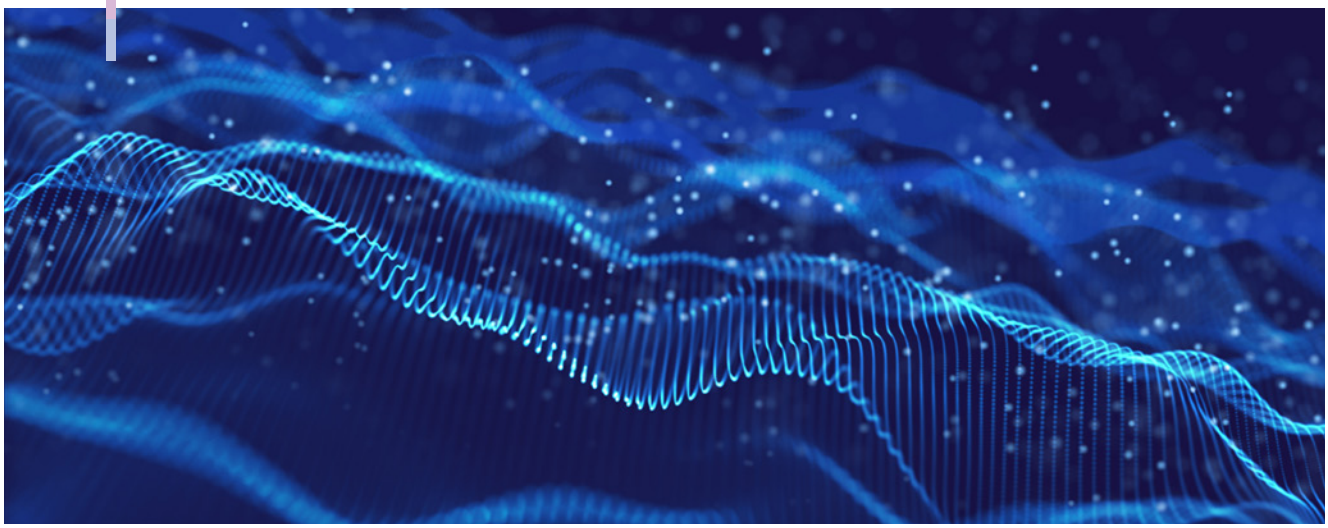
- **Innovative future-focused FinTech solutions utilising technologies like the Metaverse, Artificial Intelligence (AI), and data analytics.**
- **Optical Character Recognition (OCR) solutions for more efficiently analysing financial documents.**
- **Federated Learning solutions to speed up the financing process for MSMEs.**
- **The FinTech Future Leader Academy, a summer internship programme to nurture new talent.**

RE-INDUSTRIALISATION

Re-industrialisation (the modernisation of industry) was a highlight of the Hong Kong Policy Address 2021[3], with a particular focus on linking Hong Kong's re-industrialisation with I&T developments in Shenzhen and the GBA. A crucial step to achieve this is by developing the 5G network and enhancing semiconductor output. ASTRI has been engaging in 5G network R&D since 2018. It has developed an open 5G end-to-end network solution, and is collaborating with various industry partners to meet new market demands.

ASTRI has also established the Advanced Semiconductors Consortium, an advanced semiconductor ecosystem and technology development platform with members from across the GBA and overseas. Its goals include:

- **Engaging in direct commercialisation of technology R&D outcomes.**
- **Reinforcing Hong Kong's role as a regional I&T hub.**
- **Establishing industry standards and re-industrialisation roadmaps.**
- **Initiating demand-driven innovations and product development.**
- **Developing talent through workshops, project internships.**



DIGITAL HEALTH AND CONSTRUCTION TECHNOLOGIES

In 2021, 15.7% of Hong Kong's population, or one out of six Hong Kong people, were aged 65 or over[4]. The steady rise in the elderly population has important implications for healthcare funding and management in Hong Kong. Digital health holds answers to some of the challenges ahead. It has the potential to prevent disease and lower healthcare costs, and can help patients monitor and manage chronic conditions more easily. ASTRI's work in IoT Sensing and AI Technologies (IOTSAI) is contributing to this, with one of its core areas being health technology with a focus on Elderly Care, Smart Hospital and Medical Imaging.

However, IOTSAI is not limited to any single sector. ASTRI's IOTSAI research is also being directed to help the construction industry, where industrial accidents can be common. ASTRI's work is creating construction technologies for Safety Monitoring, Construction Robot Adoption, and Facility and Building Information Modelling (BIM) Sensing.

SMART MOBILITY: ASTRI'S C-V2X

Cellular Vehicle-to-Everything (C-V2X) technology makes real-time communication possible between vehicles and vehicles, vehicles and pedestrians, vehicles and road infrastructure, and vehicles and networks to enhance road safety and assist driving. ASTRI started developing C-V2X technology in 2016. Since 2019, ASTRI has been working closely with the Transport Department to study various application scenarios of the C-V2X technology on Hong Kong's roads. With the support of Innovation and Technology Commission through Innovation and Technology Fund, ASTRI has conducted the research and public road rest on C-V2X technology, as well as network and infrastructure requirement for future city planning. More advanced C-V2X use cases will be explored in the current project funded by Smart Traffic Fund under Transport Department through enhancing the application of C-V2X technologies with Open C-V2X system.

The next step to is to engage in collaborations leveraging ASTRI's C-V2X to build an end-to-end connected vehicles solution. This will involve connecting up different smart cities' systems, automated vehicles and road-side infrastructure, in order to manage smart mobility more effectively for individual cities and collaboratively across the GBA. Cross-boundary collaboration within the GBA area is expected to begin in 2022.

1 https://www.smartcity.gov.hk/modules/custom/custom_global_js_css/assets/files/HKSmartCityBlueprint(ENG)v2.pdf

2 https://www.hkma.gov.hk/eng/news-and-media/press-releases/2021/06/20210608-4/

3 https://www.policyaddress.gov.hk/2021/eng/

4 https://www.elderlycommission.gov.hk/en/library/Ex-sum.htm

ACHIEVEMENTS

CONTRIBUTING TO THE I&T ECOSYSTEM THROUGH PARTNERSHIPS

Throughout the year, ASTRI explored opportunities for engaging in joint research and development (R&D) projects with universities, sharing competencies across pure and applied research. The aim is to create higher value research projects and contribute to the development of Hong Kong as a hub for global research collaboration.

24 MAR 2022

ASTRI X CITY UNIVERSITY OF HONG KONG (CITYU)

ASTRI and CityU signed a Memorandum of Understanding (MoU) in March 2022 to deepen the R&D collaboration, specifically by integrating their R&D capabilities and intellectual property (IP) resources. The collaboration will support the development of start-up companies groomed by CityU's HK Tech 300 programme, a large-scale flagship innovation and entrepreneurship programme designed to promote Hong Kong's I&T development.

18 MAR 2022

ASTRI X LENOVO (HONG KONG) LIMITED

During the year, ASTRI and Lenovo (Hong Kong) Limited signed a Memorandum of Understanding that will further drive the development and promotion of ASTRI's C-V2X/CAV technology. Lenovo's strengths in technology infrastructure will support ASTRI to further enhance the V2X platform design for its upcoming C-V2X projects, to be funded by the Smart Traffic Fund and supported by the Transport Department.

01 MAR 2022

ASTRI X SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY (SUSTECH)

ASTRI's Shenzhen office signed a Memorandum of Understanding with SUSTech to establish a joint laboratory over the next five years. For its part, ASTRI will allocate RMB 5 million in funding, initiate various R&D projects, and provide technological advice. This is ASTRI's first collaboration with a university in the Greater Bay Area on a joint laboratory, and marks the beginning of wider R&D collaboration between Hong Kong and the GBA.

28 JAN 2022

ASTRI X THE HONG KONG POLYTECHNIC UNIVERSITY (POLYU)

ASTRI and PolyU signed a Memorandum of Understanding in January 2022 aiming at strengthening the collaboration on research and technology transfer and nurturing R&D talent for the future.

15 DEC 2021

ASTRI X THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY (HKUST)

In December 2021, ASTRI and HKUST signed a Memorandum of Understanding for R&D collaboration, involving leveraging the patented technologies and research strengths of both parties to develop impactful innovations. This is the first time in Hong Kong that an applied research institute and a university have officially collaborated using this approach. It will act as a model for other cross-disciplinary R&D collaborations involving the sharing of technology transfers.

6 SEP 2021

ASTRI X HONG KONG INTERNATIONAL AIRPORT (HKIA)

In September 2021, ASTRI and HKIA signed a Memorandum of Understanding intending to establish a joint research and development centre as a hub for research collaboration. The MoU aimed at facilitating an integrated and strategic co-operation to help transform HKIA into a smart airport and Hong Kong into a smart city with advanced technologies such as 5G, C-V2X, CAV, IoT, mobility, and data analytics.

ACHIEVEMENTS

ASTRI ADVANCED SEMICONDUCTOR INNOVATION AND DEVELOPMENT CONFERENCE

On 10 December 2021, ASTRI hosted the first "Advanced Semiconductor Innovation and Development Conference" with the theme "The Power of Greater Bay". The online conference brought together many well-known experts to discuss ways of fostering R&D collaborations and developing new advanced semiconductor applications, with a view to developing the GBA into an international Innovation and Technology (I&T) hub. Mr. Alfred Sit, JP, Secretary for Innovation and Technology of the HKSAR Government, Ir. Sunny Lee, BBS, JP, Chairman of ASTRI, and nearly 2,400 industry players from Hong Kong and the Mainland took part in the conference.

Welcoming participants to the conference, Mr. Cao Jianlin, former Deputy Minister of Science and Technology and now Director of Jihua Laboratory, noted that many cities in mainland China had increased their investment in the semiconductor industry due to the current chip shortage. He commented that the conference was an ideal opportunity for participants to deepen their cooperation and develop concrete plans for advancing the semiconductor industry in the GBA.

One of the keynote speakers at the event was Mr. Alfred Sit, JP, Secretary for Innovation and Technology of the HKSAR Government. He spoke about how important it was to enhance the semiconductor industrial chain in the GBA to facilitate product development, with more new technologies leading to more new products. He noted that active discussion and cooperation among stakeholders was an essential first step.

Mr. Liu Maozhou, Inspector of the Department of Educational, Scientific and Technological Affairs of the Liaison Office of the Central People's Government in HKSAR, was another keynote speaker. Noting that the GBA represents a huge market for advanced semiconductor end-use applications, he highlighted the advantages of Hong Kong in terms of its proximity to mainland China and its ability to adopt a leadership role in key technologies and cutting-edge basic research. He also pointed out that support was also available from various National Key Research and Development Programmes for companies developing innovations that meet the needs of enterprises.

In his own welcoming remarks, ASTRI Chairman Ir. Sunny Lee, BBS, JP, congratulated ASTRI for its R&D achievements in third-generation semiconductors, including its contributions to an innovation project that had obtained a First-class Prize of the "2020 State Scientific and Technological Progress Award". He added that ASTRI would do all it could to contribute to the GBA becoming an international I&T hub.

Dr. Denis Yip, CEO of ASTRI, spoke of how ASTRI was actively supporting the National 14th Five-Year Plan, and would leverage its own and Hong Kong's strengths to fully participate in the I&T development of the GBA. He emphasised the value of the conference in bringing together partners from various spheres and strengthening collaboration among I&T players, which was necessary to develop the GBA into a global I&T hub.

Under the 14th Five-Year Plan, China's third-generation semiconductor industry is developing rapidly. Given the strong basic research capabilities of universities in Hong Kong, and ASTRI's large third-generation semiconductor research team (the largest in Hong Kong) with its mastery of cutting-edge chip design technology, Hong Kong is expected to play an important role in the development of the industry in the GBA.

Hong Kong is also aiming to attract more leading overseas experts and related talents, and to strengthen collaborations with overseas researchers, enterprises and universities. This will help drive new and innovative R&D work in Hong Kong, attract more R&D funding, and strengthen Hong Kong's role as a bridge between the mainland and the rest of the world.

ACHIEVEMENTS

ASTRI THOUGHT LEADERSHIP EVENTS

ASTRI MAKES DEVELOPMENT PLANS IN SUPPORT OF INTERNATIONAL I&T HUB

In January, Dr. Denis Yip, ASTRI's Chief Executive Officer, announced a number of development plans aimed at aligning ASTRI with the vision of developing the GBA into an international innovation and technology (I&T) hub, as outlined in the 14th Five-Year Plan. The new development plans include:

- **PLANS TO EXPAND ACTIVITIES IN THE MAINLAND**

  ASTRI is considering establishing a presence in the Shenzhen Branch of the Hong Kong Science Park in Futian and the Lok Ma Chau Loop, as a way of strengthening its collaboration with ecosystem stakeholders and industry partners.

- **PLANS TO COOPERATE WITH LOCAL UNIVERSITIES**

  ASTRI will seek to cooperate with key universities in the GBA, as well as with the mainland campuses and research institutes of Hong Kong universities in the area. ASTRI is currently negotiating with the School of Microelectronics of the Southern University of Science and Technology in Shenzhen on establishing a joint laboratory. The lab, which should be established in the next few months, will conduct research on leading technologies such as advanced semiconductors, 5G communications, and intelligent manufacturing.

- **PLANS TO DEVELOP R&D PROJECTS**

  ASTRI will develop more R&D projects in the GBA with the aim of boosting technology transfer through Government-Industry-University-Research cooperation. In the first stage, priority will be given to R&D projects in integrated circuits and communications technology, and subsequently to projects in IoT and Sensors, FinTech, and artificial intelligence and big data.

- **PLANS TO EXPAND R&D RESOURCES**

  ASTRI will apply for R&D funding available to applicants from the Mainland, Hong Kong and Macau that is offered by the state or by provincial and municipal governments, as well as for funding available in the GBA. ASTRI will also continue to strengthen its collaborations with enterprise clients to expand its R&D resources.

- **PLANS TO ATTRACT AND CULTIVATE TALENT**

  To expand its mainland team, ASTRI will conduct recruitment in the Mainland and offer Hong Kong-based employees the opportunity to transfer to its mainland headquarters. Meanwhile, to nurture international-quality talent, ASTRI will engage postgraduate students in the GBA to participate in R&D by cooperating with universities and research institutes in the area.

ASTRI is also approaching a number of world-renowned universities to promote job opportunities at ASTRI to their students. These opportunities include ASTRI's Summer Internship Programme for undergraduates, its newly launched Fintech Future Leaders Academy internship programme, and job positions for bachelor's, master's and doctoral degree graduates.

LEADING EXPOS AND INDUSTRY EVENTS

ASTRI's cutting-edge 5G (Easy 5G) technologies showcased at PT Expo China

ASTRI showcased a portfolio of its cutting-edge 5G technologies at PT Expo China 2021, held in Beijing from 27-29 September 2021. Adopting the theme of "5G Innovation for Digital Future", ASTRI demonstrated technologies and innovations that are enhancing the competitive strength of enterprises in Hong Kong, the Greater Bay Area and around the world.

The showcased technologies included:

EASY 5G technology solution

- **5G O-RAN Solution**
- **5G SA Core and UPF**
- **5G MEC**

5G+AI application technologies

- **5G C-V2X for Smart Mobility**
- **Neuron Platform for Smart City**
- **5G AGV solution for Industrial IoT**
- **Perception and High Precision Positioning Technology**

PT Expo China is the ICT ecosystem's leading annual event, hosted by the Ministry of Industry and Information Technology of China. It provides an international platform and networking opportunities for the ICT ecosystem in research and development, applications, and market trends.

InnoCarnival 2021

ASTRI's pavilion at InnoCarnival 2021 adopted "Tech for Impact" as its motto. Showcasing a wide range of ASTRI's cutting-edge Smart City technologies, the pavilion attracted many young people and families visiting InnoCarnival 2021, introducing them to Hong Kong's Smart City ambitions and inspiring them with the promise of technology for a better future.

Among the many distinguished individuals who visited ASTRI's pavilion were a number of senior Government officials, including Financial Secretary Mr. Paul Chan, GBM, GBS, MH, JP; Secretary for Innovation and Technology Mr. Alfred Sit, JP; and Legislative Council member Hon Elizabeth Quat, BBS, JP. They were welcomed by ASTRI's Chairman Ir. Sunny Lee, BBS, JP; CEO Dr. Denis Yip; CTO Dr. Lucas Hui and COO Dr. Martin Szeto, who briefed the visitors on ASTRI's Smart City projects and technologies.

ASTRI's tech experts also joined in a series of webinars at the InnoCarnival, where they introduced our Next Generation Cold Food Import Safety Management Platform, C-V2X System, and Power Supply System for Direct Current Building.

Cutting-edge ASTRI technologies showcased at InnoCarnival 2021 included:

- **C-V2X System**
- **AR Field Service Solution**
- **Wireless LoRaWAN Smart Water Metering System**
- **Easy 5G solutions**
- **Learning Platform for Children with SEN**
- **Federated Learning for MSME financing by AI and Machine Learning**

International ICT Expo 2021

In October 2021, ASTRI took part in the International ICT Expo 2021, organised by the Hong Kong Trade Development Council. The ASTRI pavilion introduced a number of our Smart City projects in the areas of Smart Economy, Smart Environment, Smart Mobility, and Smart Living. CEO Dr. Denis Yip, CTO Dr. Lucas Hui and COO Dr. Martin Szeto welcomed Secretary for Innovation and Technology Mr. Alfred Sit, JP, to the pavilion, and introduced him to Smart Mobility highlights such as our C-V2X system, Connected Autonomous Vehicle (CAV) technologies, and Autonomous Vehicles.

ASTELLA and ASTRI Collaborate to Showcase New 5G Integrated Small Cells

ASTRI collaborated with Astella Technologies Limited (ASTELLA) and other 5G industry leaders to deliver a live, 5G end-to-end demonstration of integrated small cells at the Mobile World Congress 2022, held in Barcelona from 28 February to 3 March 2022.

ASTELLA 5G integrated small cells can be deployed both indoors and outdoors, and support FR1 and FR2 frequency bands. When integrated with 5G Multi-access Edge Computing (MEC) and 5G Core from ASTRI, ASTELLA 5G solutions are highly cost competitive for new 5G use cases such as industrial internet of things (IoT), NR Vehicle-to-Everything (V2X), and 5G mission critical applications.

BUILDING THE TECH ECOSYSTEM

ASTRI develops Next Generation Food Safety Management Platform for smart import of frozen meat

ASTRI has adopted blockchain and Internet of Things (IoT) technologies to create the "Next Generation Cold Food Import Safety Management Platform". The platform digitises and enhances the monitoring and control of the import of frozen or chilled meat from mainland China.

The Next Generation Cold Food Import Safety Management Platform stores all import documents and container temperature data on the blockchain. Those who have been granted access rights, including farms, processing plants, importers and exporters, and approval units, share the same documents and data to ensure consistency. Trucks can use the Global Positioning System (GPS) to record their driving routes, and use an advanced electronic lock and thermometer to monitor the status of the container door and the temperature inside. This information is uploaded to the system platform and stored on the blockchain in real time.

ASTRI's partner China Chippacking Technology successfully lists on Shanghai Stock Exchange

Following a multi-year strategic partnership between ASTRI and China Chippacking Technology Co., Ltd, the latter company was successfully listed on the Science and Technology Innovation Board of the Shanghai Stock Exchange in June 2021. ASTRI was invited to the listing reciprocal banquet, which was attended by Ms. Tina Yang, ASTRI's Director of Mainland Strategy and Operations.

ASTRI and Chippacking Technology have been partners for many years. Chippacking Technology focuses on providing customers with competitive packaging and testing products, while ASTRI's Integrated Circuits and Systems (ICS) Technology Division is committed to researching and developing advanced packaging technologies. The parties have jointly developed many advanced packaging technologies and products that have improved product performance and reduced packaging and testing costs. Joint projects by the two parties were among the first products to have been developed and mass-produced on the three-dimensional packaging pilot line in the Hong Kong Science Park.

ASTRI leverages privacy-preserving "Federated Learning" technology to facilitate credit scoring for MSME financing

During the year, ASTRI joined forces with other tech-embracing companies in developing solutions to help micro, small and medium-sized enterprises (MSMEs) get access to financing. To do this, it leveraged "Federated Learning" privacy-preserving technology to develop artificial intelligence (AI) models and output in the form of encrypted parameters that could serve as a reference for financial institutions looking to conduct comprehensive credit analysis on MSMEs. ASTRI's partners in this enterprise were Standard Chartered Bank (Hong Kong) Limited; Ping An OneConnect Bank (Hong Kong) Limited (Ping An OneConnect Bank or PAOB), the first virtual bank serving MSMEs in Hong Kong; OpenRice, a Hong Kong restaurant guide and review platform; and FreightAmigo, a logistics and freight pricing platform.

Unlike traditional machine-learning methods, Federated Learning does not require data to be transferred directly to a central database, thus protecting privacy and mitigating the risk of data security breaches. Data partners and financial institutions can establish common credit evaluation models by combining their encrypted parameters. During the process, the collaborators do not have access to any personal consumer data, nor are the identities of the enterprises identified. Only when an enterprise applies for financing and is undergoing authorisation can the designated financial institution obtain the relevant parameters and conduct a credit evaluation.

CITIC Telecom CPC and ASTRI Partnership Expands Business Innovation Possibilities With AI-AR Integration

In late 2021, CITIC Telecom International CPC Limited (CITIC Telecom CPC), a wholly-owned subsidiary of CITIC Telecom International Holdings Limited (SEHK: 1883), entered a new phase in its partnership with ASTRI. In this phase, the collaborators began exploring AI and augmented reality (AR) innovations by combining CITIC Telecom CPC's expertise in algorithms and AI with ASTRI's capabilities in AR innovation. Together they are exploring new industry use cases using AI/AR integrated solutions that are ready for commercialisation.

CITIC Telecom CPC first established a partnership with ASTRI in June 2019, exploring digitalisation and AR. The partnership led to the successful launch in September 2020 of an AR Remote Hand Solution that effectively boosted field service productivity by up to 50%. The solution included enhanced AR-based glasses that allow field engineers to access vital information at data centres, and that enable seamless collaboration between frontline and back-end teams to complete maintenance tasks. The solution also demonstrated how companies could facilitate remote work strategies during the pandemic using AR technologies.

In Phase 2, CITIC Telecom CPC and ASTRI are taking a significant leap forward by integrating their AI & AR capabilities. ASTRI will provide the software platform and customisation, while CITIC Telecom CPC's team will build an innovative Machine Learning model by integrating big data, AI, virtual and physical data into the heads-up display of the AR Glasses.

COMMUNICATIONS TECHNOLOGIES (CT)

The Communications Technologies (CT) Division delivers cutting-edge tools and applications based on 5G and other next-generation network solutions. Its innovative applications are helping equipment manufacturers and operators to introduce faster and more intelligent services for network users, benefitting both industries and the community.

INDUSTRIES SERVED

CT works closely with agencies of the Hong Kong SAR Government, telecommunication service providers, universities and R&D institutions. It is supporting Hong Kong's overall Smart City goals and the development of the GBA through its work on standards, solutions and infrastructure, especially in 5G-related technology.

CT's Core Competence Groups develop open broadband wireless networks and applications, as well as 5G Open-Radio Access Network (O-RAN) infrastructure. They focus on creating new technology infrastructure and platforms for a wide range of sectors and applications. The Division also offers end-to-end 5G system solutions (named Easy 5G) to players in the industry ecosystem.

CORE COMPETENCE GROUPS

- BASEBAND SOLUTIONS
- EMERGING SYSTEMS
- NETWORKING SOFTWARE
- MOBILE AND IOT PLATFORMS
- MEDIUM ACCESS CONTROL AND INTELLIGENT SOLUTIONS

Baseband Solutions (BSOL)

BSOL develops industry leading 5G wireless solutions and reference designs (technical blueprints for copying) for the industry. It specialises in baseband algorithms, L1-L3 embedded software, digital signal processing (DSP) and field-programmable gate array (FPGA) reference designs based on open platforms. The team develops low-cost, high quality and cutting-edge 5G and beyond radio communications systems for both public and private telecommunication networks. Its technology competences include enhanced mobile broadband (eMBB), ultra-reliable and low latency communications (URLLC), and massive machine-type communications (mMTC).

Emerging Systems (ESYS)

ESYS develops open platform-based radio access technologies for 5G cellular systems, which increase spectrum efficiency while reducing hardware costs and energy consumption. It is also developing forward-looking radio access technologies such as 5G and beyond communications systems including high-mobility communications for applications such as high speed railways, vehicular ad hoc networks, and unmanned aerial vehicles (UAVs) communications, Non-Terrestrial Network (NTN) - including satellite segments in an 5G system, and vehicle-to-everything communication systems. Digital front-end technologies for both sub-6 GHz and millimetre wave frequency are investigated.

Networking Software (NSOFT)

NSOFT is involved in the development of end-to-end networks to serve Smart Mobility and Smart City infrastructure and applications, as well as Industry 4.0. Its fully standard compliant 5G Core and Multi-Access Edge Computing (MEC) technologies have been commercially verified, and provide a reliable, secure, ultra-low latency, high performance, zero-touch deployment network ready for enterprise and commercial markets. NSOFT is continuing to address market needs for new verticals, such as Time Sensitive Communication (TSC), Ultra Reliable and Low Latency Communication (URLLC), and Vehicle-to-Everything (V2X) Communication.

NSOFT is also developing advanced Intelligent Transportation Infrastructure and Networking solutions, including 5G enabled C-V2X end-to-end infrastructure (in-vehicle, roadside, edge and cloud system), the Connected Autonomous Vehicle System (CAV), 5G ICT infrastructure, the Smart Mobility Roadside System with advanced sensor and application technologies, and the Advanced Planning and Simulation System for Intelligent Transportation. After launching one of the world's largest C-V2X public road tests in Hong Kong in 2021, the team has continued to carry out research and test projects related to the C-V2X technology through Hong Kong Smart Traffic Fund (STF) projects. The team is also working to expand cross-boundary collaboration within the Greater Bay Area.

Mobile and IoT Platforms (MIP)

MIP develops technologies and total system solutions aimed at realising the potential of mobile applications and IoT. Its innovations are enabling communication systems to accommodate the vast amounts of network traffic triggered by millions of devices and mobile users, while working cohesively with cloud resources that can scale horizontally instead of vertically. It focuses on developing and advancing proximity, geographic information, and real time telemetric-related technologies for applications such as positioning, navigation, map rendering, sensor data processing, smart distributed gateways, IoT blockchain and advanced IoT tracking systems.

Medium Access Control and Intelligent Solutions (MACI)

MACI develops medium access control technologies and conducts technical cooperation and system integration with other CCGs, providing overall 5G solutions for smart factories, smart mobility, smart cities and 5G enterprise networks. The team has a good track record in commercialising wireless technologies, allowing its customers to win tenders of small cells based on ASTRI design. Extensive collaborations are pursued with industry partners, particularly in Hong Kong and the Greater Bay Area, as well as with Hong Kong Government agencies and public groups.

KEY TECHNOLOGIES

- EASY 5G END-TO-END NETWORK TECHNOLOGIES (5G O-RAN BASE STATION, 5G CORE, MOBILE EDGE COMPUTING, AND ORCHESTRATOR)
- 5G RAN TECHNOLOGIES FOR MISSION CRITICAL INTERNET OF THINGS
- 5G NR SPECTRUM SHARING TECHNOLOGIES
- 5G CORE FOR VIRTUAL AND ENTERPRISE OPERATIONS
- SMART CITY 5G ICT INFRASTRUCTURE
- C-V2X ROADSIDE INFRASTRUCTURE SOLUTION FOR SMART MOBILITY
- 3D GIS INDOOR NAVIGATION, AND 5G EDGE RENDERING OF 3D INDOOR MAP
- IOT AND DISTRIBUTED LEDGER FOR 5G

R&D HIGHLIGHT

5G NR Optimised Heterogeneous Networks

With 5G networks being rapidly deployed internationally, many new use cases have introduced diverse requirements for coverage area and performance. It is expected that 5G networks will adopt a HetNet (heterogeneous network) architecture, where 4G/5G macro cells are used to provide coverage with 5G small cells providing enhanced services, whereas low-, mid-, and high-frequency spectrum bands are used together to achieve wide coverage and/or high throughput.

This project delivers a new 5G NR (New Radio) HetNet base station reference design to enable mobile operators to provide flexible 5G network deployment and services in a shorter time and lower cost.

R&D HIGHLIGHT

3D Geographic Information System (GIS), Indoor Navigation, and Feasibility Study on 5G Edge Rendering of 3D Indoor Map

As part of Hong Kong's Smart City development, the Lands Department has been tasked to create 3D digital maps of Hong Kong, mainly of outdoor areas but some indoor areas too. To facilitate this, an open platform acting as a carrier for the 3D map data is required, be accessed by application developers and the general public. This will assist in the scalable and sustainable build-up of the Common Spatial Data Infrastructure (CSDI) for Smart City development.

This project is developing a 3D Geographic Information System (3DGIS) management platform for common spatial data and indoor positioning assistant devices, in order to provide 3DGIS map and 3D indoor positioning services. The platform features a standardised workflow that enables owners of premises to define private internal layouts as 3D indoor maps for rendering on top of the Lands Department's base map. A feasibility study is also being conducted to investigate a more efficient map mechanism at the 5G mobile edge, to enable faster rendering of 3D indoor maps. This project is designed to complement the Lands Department's 3D indoor map work and provide the public with a better user experience.

R&D HIGHLIGHT

5G Standalone (SA) Core Network

The 5G Standalone (SA) core network is one of key network elements in an end-to-end 5G network for allowing reliable and secure connectivity to network services. The architectural design of ASTRI's core is fully compliant to the 3GPP specifications and it is cloud-native: its open, modular structure, coupled with 5G Service Based Architecture (5G SBA) make it practical and flexible to introduce future network functions and allow any function to be implemented and scaled, rapidly, whenever, and wherever required.

This project is to implement all the major network functions in the 5G SA core with enhanced features and is intended to be lightweight to significantly reduce the cost and complexity for private 5G networks. Riding on ASTRI's leadership in 5G core user plane function (where it has achieved market-leading 1.3Tbps performance), the project team has been engaging with many industry players and partners to create 5G applications. Already more than 10 companies are collaborating with ASTRI on this project and will adopt the technologies developed in it.

R&D HIGHLIGHT

Smart City 5G ICT Infrastructure and Smart Mobility Roadside Infrastructure

The first project is developing Smart City infrastructure leveraging 5G, giving the ability to flexibly build applications. It includes flexible sharing of network resources between access edge, data centre edge and centralised cloud; flexible reuse of network infrastructure to support multiple applications; and service orchestration to allow data sharing between data sources (e.g. cameras/sensors). The project is also developing some specific Hong Kong use cases for Smart Mobility and Smart Government.

The second project is working on Smart Mobility Roadside System software. The software includes a sensor fusion engine to collect, synchronise and aggregate roadside sensor data; an intelligence engine to determine roadside situations and provide real-time policy actions; a policy engine; and edge interfaces to support the exchange of standard V2X messages and information between vehicles and roadside infrastructure. Traffic Simulation software is also being developed for network planning and performance verification purposes.

OTHER R&D PROJECTS

PROJECT	FOCUS
5G NR Optimized Heterogeneous Networks	Smart City
5G Mobile Broadband Small Cells	Smart City
Evolution of Mission Critical Internet of Things – PHY Layer System	Smart City
Evolution of Mission Critical Internet of Things – MAC Procedure and Edge Applications	Smart City
IoT And Distributed Ledger For 5G	Smart City
5G NR Spectrum Sharing – MAC procedure	Smart City
5G NR Spectrum Sharing - PHY reference design	Smart City
5G Core for Virtual and Enterprise Operations	Smart City
Data Packet Handling Mechanisms Study in 5G Core for Deterministic Network	Smart City, Re-industrialisation and Intelligent Manufacturing

TRUST AND AI TECHNOLOGIES (TAIT)

The Trust and AI Technologies (TAIT) Division, with its strong expertise in AI, blockchain, cybersecurity and data analytics, aims to research and develop innovative and robust applications and collaborate with various industry partners.

INDUSTRIES SERVED

TAIT's research, conducted by seven core competence groups, can be applied in many sectors and industries, including banking, insurance, retail, logistics, law enforcement, public services, and telecommunications. One of its major goals is to help to position Hong Kong as a premier international FinTech hub.

CORE COMPETENCE GROUPS

- APPLIED CRYPTOSYSTEMS
- CYBERSECURITY & ANALYTICS
- DATA ANALYTICS
- MULTIMODAL IMAGE ANALYTICS
- MULTIMEDIA SYSTEMS AND ANALYTICS
- SECURED SYSTEM PLATFORMS
- COMPUTATIONAL LINGUISTICS AND INTELLIGENCE (CLI)

Applied Cryptosystems (ACS)

ACS explores technologies related to the application of cryptography and federated learning in different industry sectors, focusing on developing trusted technologies for privacy preservation, fintech security, crypto tokens, and multimedia analytics. One recent deliverable was a federated learning solution for alternative credit scoring with privacy preservation and customer recommendations for the banking sector. ACS is looking to expand into the insurance and digital health sectors.

Computational Linguistics and Intelligence (CLI)

CLI leverages state-of-the-art AI algorithms and machine learning technologies to provide machine perception-related speech recognition, natural language processing and generation, image and video analysis, and virtual character generation.

Cybersecurity & Analytics (CSA)

CSA is involved in research into cyber-threat hunting and analysis. In an age where the bulk of institutional and personal data is stored online, the increasing frequency and sophistication of cyberattacks poses a major threat. The CSA team applies data analytics, machine learning and AI-powered tools to combat cyber threats, combining human skills with advanced hardware-software capabilities to help businesses and the community.

Data Analytics (DATA)

DATA specialises in developing scalable, real-time big data analytics platforms and advanced AI solutions using deep learning or machine learning technologies to support various industries. Its core technology competencies include natural language processing (NLP) and named entity recognition (NER), Knowledge Graph construction and reasoning, graph analytics, predictive analytics, and AI recommendations, used to support applications in Fintech, Regtech, digital marketing, and Smart City. Recent work has included AI document analysis for RegTech, Knowledge Graph and graph analytics for crime analytics, and AI recommendations for smart advertising.

Multimodal Image Analytics (MMIA)

MMIA deals with technology for acquiring, analysing, and processing multi-modal images. Its technology development covers hardware, firmware, software, and algorithms, with algorithms focusing on image processing, machine learning or deep learning, computer vision and simultaneous localisation and mapping (SLAM). The team is currently focusing on Intelligent Medical Imaging Devices and Computer-Aided Diagnosis (CAD) of images, VR/AR technologies and 3D imaging, with the aim of providing high-performance application solutions for Digital Health and Smart City.

Multimedia Systems and Analytics (MSA)

MSA provides solutions across different captured media in multiple dimensions. Its solutions are currently being deployed in Smart Government, FinTech, InsurTech, and Smart City. Its algorithm developments cover image and video processing, handwritten character recognition, AI, computer vision, NLP, and document analysis and processing. The team's output includes an automated form/document processing system, an automated content processing platform, fraud detection for insurance claims, and character recognition engines.

Secured System Platforms (SSP)

SSP focuses on software and hardware technologies for secure platforms and solutions. It develops blockchain systems and open data solutions to provide solutions for industries. It also researches in AI enabled robotic process automation (RPA) technology to raise financial process efficiency. Regarding hardware solutions, the team is currently developing a RISC-V based Trusted Execution Environment for IoT and wearables devices. SSP has helped many corporations by building robust blockchain platforms for property mortgage, insurance, and supply chain companies, as well as developing hardware security IP for chip design companies.

KEY TECHNOLOGIES

- CYBERSECURITY
- MEDICAL IMAGING ANALYTICS AND DEVICES
- AR APPLICATIONS
- BLOCKCHAIN PERFORMANCE AND SECURITY
- PRIVACY ENHANCING TECHNOLOGIES
- KNOWLEDGE GRAPH
- HARDWARE SECURED PLATFORMS
- DOCUMENT PROCESSING AND AUTOMATION
- SPEECH RECOGNITION OF CANTONESE MIXED WITH ENGLISH, MANDARIN
- LANGUAGE PROCESSING OF CANTONESE, MANDARIN, ENGLISH
- TEXT TO SPEECH IN CANTONESE, ENGLISH, MANDARIN
- SENTIMENT ANALYSIS ON TONE AND TEXT
- CHATBOT AND VOICEBOT
- VIRTUAL CHARACTER GENERATION AND VIDEO SYNTHETISATION

R&D HIGHLIGHT

Project Aurum – Technical Study on Retail Central Bank Digital Currency (CBDC)

This project is being carried out in collaboration with the Bank for International Settlements (BIS) Innovation Hub and the Hong Kong Monetary Authority (HKMA). Its goal is to build a proof-of-concept CBDC system with an emphasis on safety, flexibility, and privacy. There are two major parts in the system. It has a wholesale part built on blockchain technologies, for secure collaboration between a central bank and commercial banks, and a retail part designed to deliver high performance while protecting user privacy.

The platform includes several unique features, including transaction traceability, user identity privacy, auditability, transaction fraud detection and prevention, and transaction security, all of which are being thoroughly evaluated. The project will serve as a basis for future CBDC technology research and application development.

R&D HIGHLIGHT

AI Algorithm Optimisation Platform for Medical Image Analytics

This project is enhancing the development of Computer-Aided Diagnosis (CAD) for the medical domain. We have built an AI algorithm optimisation platform to mitigate the impact of insufficient data, high annotation costs and inaccurate annotation on model accuracy, and to speed up processing through sparse optimisation technology. We are also developing Deep Learning (DL)-based CAD solutions for digestive tract endoscope image analysis, leveraging the optimisation framework to create a model design with higher sensitivity and specificity, along with the ability to achieve real-time processing with limited computing resources.

The AI engine system we developed for the early detection of early gastric cancer with white light gastroscopy has been set up in some hospitals, where it is docked with conventional endoscope systems such as those by Olympus and Fujifilm. Field tests have verified that the AI engine system is working well.

The technologies developed in this project can greatly improve traditional endoscopy, reducing doctors' workloads and improving the detection rate of upper gastrointestinal diseases. They are bringing benefits to the government, hospitals, medical solution providers and the public.

R&D HIGHLIGHT

Smart Agent with Virtual Image

Leveraging AI, voice recognition and generation, and natural language processing (NLP), ASTRI has purpose-built and commercialised various AI chatbot & voicebot and speech-to-text solutions that are able to process locally-spoken Cantonese (mixing Cantonese, local slang, English and Mandarin) in Hong Kong.

By adding a virtual avatar, with voice cloning and video synthesisation, a Smart Agent with a virtual image can be generated. The Smart Agent can be used to provide customer services such as service introductions, market promotion and sales. The technology can be used to address customer service requirements across different sectors, including public services, financial and retail services.

R&D HIGHLIGHT

Cross-platform Advertising Optimisation for Decision Intelligence

The availability of different online advertising platforms has made cross-platform digital marketing analytics important for advertisers looking to achieve a high ROI (Return on Investment).

This project is developing a cross-platform performance evaluation tool over multiple advertising platforms (such as Google Ads and Facebook Ads), as well as optimisation solutions to increase ROI. The proposed methodology applies AI technology combined with domain expertise to address the diversity of various advertising platforms, identifying hidden connections among advertising campaigns and generating optimisation suggestions.

This project has the potential to greatly enhance the cross-platform efficiency and effectiveness of online advertising. Digital marketing providers can use it to become more competitive by providing advertisers with holistic solutions that involve lower costs and less manpower.

R&D HIGHLIGHT

Robust Form Recognition Platform

The recent development of deep learning technology and more advanced machine learning algorithms for handwritten character recognition have made it possible to automate the processing of forms. However, due to large variations in handwriting styles and form designs, recognition of handwritten characters on forms still cannot be easily automated.

This project is developing a form recognition platform that can robustly recognise handwritten characters and feed the recognised results into data for human review. The platform consists of several new technologies designed to improve recognition rates and an integrated user-friendly UI for users to review the recognised results easily. A new machine learning platform has been developed to enable the Hong Kong Police Force to train their recognition models on their data on-premises. The model management platform will be integrated with the administrator portal for the superuser to choose the recognition model.

The Inland Revenue Department (IRD) has also performed a pilot trial of the form recognition platform by feeding recognised results into the double key data entry of BIR60 (Tax Return - Individuals). It is expected that manual data keying efforts can be reduced and efficiency in processing tax returns can be increased.

OTHER R&D PROJECTS

PROJECT	FOCUS
Application of Augmented Reality (AR) and Artificial Intelligence (AI) for Vehicle Examination and Associated Trainings	Smart City
IoT Cyber Intrusion Detection and Prevention System	Smart City
Trusted Execution Environment for IoT Devices	CNERC
Data Visualization and Computer Vision Framework for Enterprise Augmented Reality (AR) Applications	Smart City
Smart Handheld Ultrasound Device with Improved Image Quality	Digital Health
Early Threat Hunting and Anticipation Network	FinTech
Deployment Environment of Privacy Preserving Profiling Applications for Federated Learning	FinTech
Enabling High Efficiency AI on Multi-Configuration Edge Computing Platform for Medical Image Analytics	Digital Health
Cost-effective Miniature Ultrasonic Probe Diagnosis Platform	Digital Health
Sandbox Environment for Smart Contract Assessment	FinTech
Smart Virtual Agent Accelerated with Transfer Learning for Customer Service	Smart City
Trial: AI-based Online Product Review System for Enhancing Efficiency and Automation	Smart City
Intelligent Audio Indexer Based on Semantic and Non-semantic Information	Smart City

INTEGRATED CIRCUITS AND SYSTEMS (ICS)

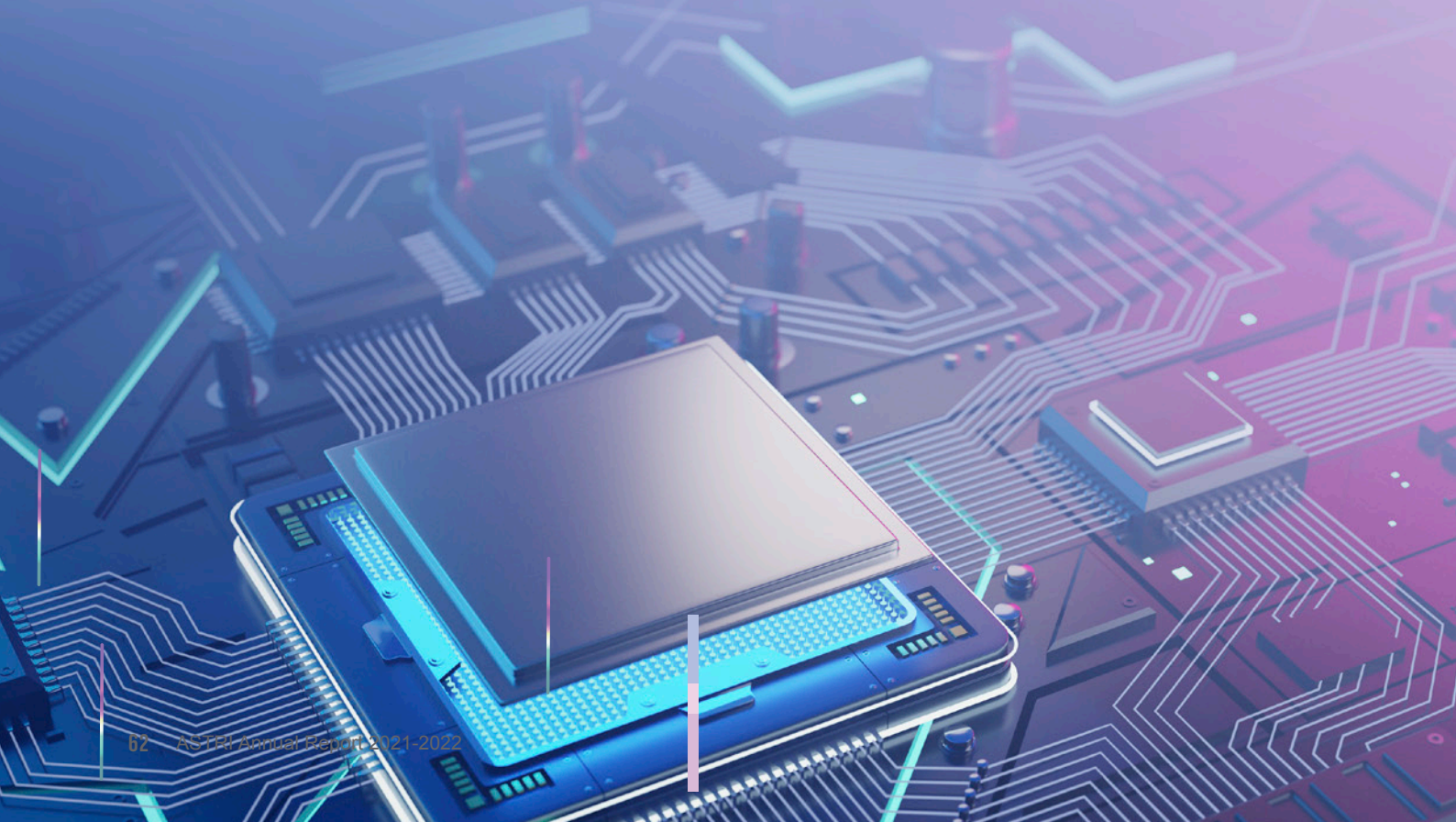
The Integrated Circuits and Systems (ICS) Division develops high-value-adding technologies for power and radio frequency (RF) related integrated circuits and systems, helping to enhance local industrial competitiveness in Smart City and Industry 4.0. The division specialises in advanced semiconductor technologies, covering 3rd generation semiconductor devices, AI chips, wireless IoT chips, 3D integration, Silicon Carbide (SiC) and Gallium Nitride (GaN) based new power and energy storage systems, and more. ICS is also a key constituent of the first Hong Kong Branch of the Chinese National Engineering Research Centre (CNERC). CNERC is located within ASTRI and focuses on research, technology transfer, and talent nurturing relating to Application Specific Integrated Circuits.

INDUSTRIES SERVED

ICS caters to various technology-centric industry verticals, which include data centres, robotics, new energy vehicles, power and charging systems and high-speed trains.

CORE COMPETENCE GROUPS

- 3D INTEGRATION
- SMART POWER AND ENERGY SYSTEMS
- RF SYSTEMS
- IC ENABLING TECHNOLOGIES
- MACHINE LEARNING PLATFORMS



3D Integration (3DI)

3DI provides comprehensive advanced solutions for electronics packaging and power electronics products, specialising in varieties of Silicon, Silicon Carbide (SiC) and Gallium Nitride (GaN) based packages, modules, subsystems and drivers/power management ICs. The application domains served by 3DI include 5G networks and infrastructure, data centres, industrial robots, new energy vehicles, power conversion, energy storage and charging systems, and railway transportation.

Smart Power and Energy Systems (SPES)

SPES develops innovative SiC- and GaN-based new power and energy storage technologies that will enhance energy efficiency and optimise power usage in Smart City and industrial applications.

RF Systems (RFS)

RFS provides wireless connectivity chips with a state-of-the-art low power integrated circuit design for IoT applications. These solutions include Bluetooth Low Energy (BLE) supporting audio streaming applications (LE Audio), Narrowband Internet of Things (NB-IoT) and 5G IoT (RedCap). All these technologies facilitate Smart City and Smart Home development and enable a wide range of connectivity solutions for personal, industrial and other systems.

IC Enabling Technologies (ICET)

ICET provides solutions for ESD protection, customised I/O library and high-speed interface applications. Its core competencies include virtual fabrication, IP porting and I/O library design. The team has developed comprehensive IP portfolios, including area efficient ESD structure IPs, IP migration technique and process independent scalable I/O libraries. It collaborates closely with IC foundries and design houses in developing fundamental IPs and special devices, and has successfully delivered devices and I/O related fundamental IPs from 0.5nm to 16nmFinFET processes.

Machine Learning Platforms (MLP)

MLP develops AI chips for image processing and computer vision applications. The team has a particularly strong specialisation in Deep Neural Network (DNN) optimisation, dataflow neural network processor design, and AI algorithms. It also innovates hardware-enabled solutions for intelligent video production, smart cameras, smart locks and various smart devices.

KEY TECHNOLOGIES

- 3D INTEGRATED CIRCUITS
- 3RD GENERATION SEMICONDUCTOR POWER PACKAGES/MODULES
- DC POWER BUILDING
- WIRELESS POWER TRANSFER
- ENERGY STORAGE SYSTEMS
- SMART POWER HUBS
- FINFET EDA
- NB-IOT
- RF TRANSCEIVER
- AI CHIPS

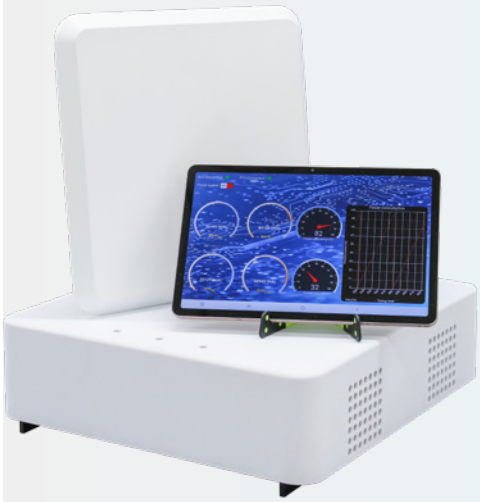
R&D HIGHLIGHT

3D Integrated Wireless Power Transmission Platform for Robotics Application

This project is developing a revolutionary robot charging mechanism via a 3D integrated wireless power transmission (WPT) platform. The technology platform provides an "all-in-one" SiC-based wireless power solution, whose enhanced efficiency, safety, productivity and intelligence makes it much more competitive than existing market products.

The key platform technologies cover packaging, module and sub-system levels, including:

1. an Easy-SiC power module with application of SiC power devices to reduce form factor and power loss and improve thermal performance;
2. an adaptive compensation network and magnetic integrated coil to ensure efficient operation under a wide load range;
3. temperature-driven dead time control and dynamic feedback algorithms to maximise power transmission efficiency; and
4. an all-in-one WPT solution with 3D integration and conduction-driven thermal solution to boost thermal performance, power density and energy efficiency.



According to Credence Research 2019, the global WPT market is expected to reach US$ 15.2 billion in 2026, with industrial robotic applications occupying 25% of the market and rising. ASTRI's 3D integrated WPT system is principally designed to power automatic guided vehicles (AGVs), autonomous mobile robots (AMRs) and robots, and can be extended to apply to areas such as smart home, smart catering and consumer electronics. The project achievements will be made available to the entire power electronics industry, helping companies in Hong Kong and China to enhance their technological competitiveness and expand their share in the global marketplace.

The project IP won a gold medal at the International Exhibition of Inventions Geneva 2022.

R&D HIGHLIGHT

Eco-friendly Power System for 5G Applications

According to an analysis by BloombergNEF, the global stockpile of retired EV battery packs will exceed 3.4 million in 2025. It is common knowledge that disposing of obsolete batteries can harm human health and the environment. Less well known is the fact that retired EV batteries still have around 70% of energy capacity remaining, and can be re-used to generate economic and environmental benefits for the society. In the light of this, ASTRI has designed an eco-friendly solution to regenerate used EV batteries from solid waste to a stationary energy storage system, helping to drive the transition to a carbon-neutral economy.

This project involves the development of a "Fast & Reliable Battery Screening Platform" to identify qualifying EV battery packs, as well as a real-time AI-based battery monitoring and protection system to evaluate battery performance and safety. It also utilises a type of phase change material to ensure that re-employed battery packs are able to resist extreme weather.

The project aims to deliver a comprehensive engineering solution for re-employing aged EV battery cells for use as a power supply for portable analysers and as backup power sources for smart city infrastructure applications (e.g. 5G base stations and smart lampposts).

The project IP won a silver medal at the International Exhibition of Inventions Geneva 2022.

R&D HIGHLIGHT

Intelligent-ISP for Video Enhancement under Extreme Light Conditions

Camera imaging is a vital part of many applications, and a major driver for AI development. A key performance indicator is video/image quality in dim light or dark conditions, and surveillance, drone, and advanced driver-assistance systems have not solved this problem satisfactorily. It is hard to tune the fixed pipeline separated function modules and limited functionalities in the current image signal process (ISP) to meet the needs of the fast-growing number of applications using camera imaging.

This project tackles the current ISP technical difficulties by using a learning-based ConvNet to combine the key function modules in the traditional ISP, extend their functionalities based on real application requirements (such as video quality enhancement under dark conditions), and optimise the end-to-end algorithms globally to achieve optimal video/image output. Patents for this technology have been filed in the US and China.

The intelligent ISP solution can reduce the time and manpower required in traditional ISP parameter tuning and provide better image/video quality for AI applications. Moreover, the quality of videos/images from low-end CMOS sensors can also be enhanced using this solution to reduce system costs.

The project IP won a silver medal at the International Exhibition of Inventions Geneva 2022.

OTHER R&D PROJECTS

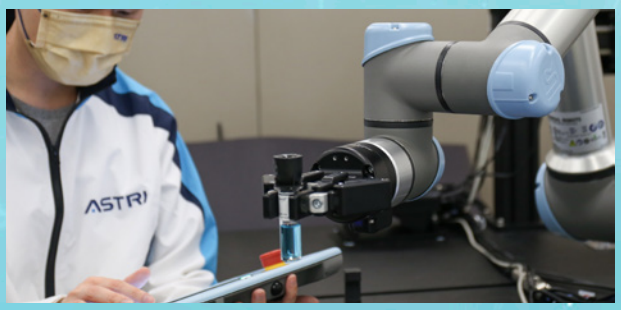
PROJECT	FOCUS
SiC Diode with Deep Superjunction to Achieve High Current Density & Breakdown Voltage	ASIC
Ultra-Efficient Ultra-Wdie Load Range Power Conversion Platform for DC Building Applications	Smart City
A Novel Electromagnetic Interference Filter for GaN-based Power Converters	ASIC
Online Battery State Inspection Module for Smart City Applications	Smart City
Heterogeneous FPGA Architecture for AI Computing	Smart City
Optimal Charging Control of Energy Storage System in AGV Application	Smart City
Smart Power Hub with Silicon Carbide Module	ASIC
Hardware enabled Privacy and Security Technology for smart home	ASIC
3D Integrated Wireless Power Transmission Platform for Robotics Applications	ASIC

IOT SENSING AND AI TECHNOLOGIES (IOTSAI)

IOTSAI has five core competence groups specialising in developing and commercialising market-driven solutions, and which between them have accumulated more than 200 granted invention patents and made 160 technology transfers to industry. In recent years, IOTSAI has stepped into new areas such as automatic optical inspection (AOI) and high precision 3D metrology for quality inspection, AI-based defect detection and classification technology for intelligent manufacturing, AR/VR & human-machine interaction sensing for metaverse applications, dynamic AI vision for construction, logistics and facility inspection-related applications, micro & nano photonics (diffractive optics/metalens) for mobile 3D sensing and security control, and mini-spectroscopy technology for applications related to smart living and environmental protection.

INDUSTRIES SERVED

IOTSAI serves many different industries in Hong Kong, the Greater Bay Area and beyond. Its sophisticated sensing and optical solutions support smart factories and a wide range of Smart City applications by enabling automation and boosting productivity. Its industrial business partners include tier-1 manufacturers of mobile phones, electrical and optical components and head-mounted display products, along with Mainland and local enterprise companies and new start-ups looking for sensing solutions for smart security control, smart education, and smart living. The division has also developed efficiency solutions for local government departments.



CORE COMPETENCE GROUPS

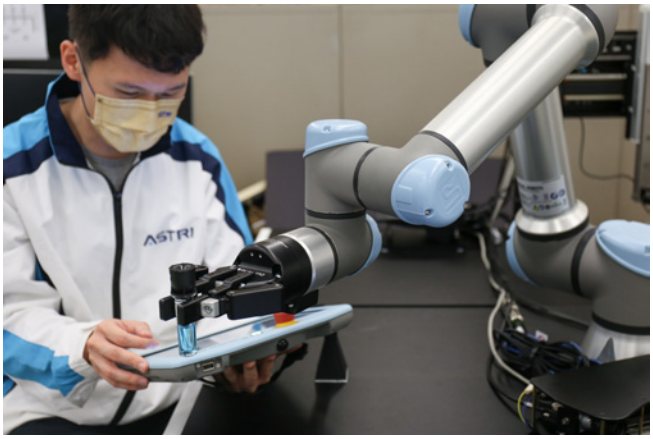
- INTELLIGENT MACHINE VISION
- EMERGING SENSING AND DISPLAY SYSTEM
- SENSING DEVICES AND INTEGRATION
- CYBER-PHYSICAL SYSTEMS (CPS)
- INTELLIGENT IOT SYSTEM (IIOTS)

Cyber-Physical Systems (CPS)

CPS uses Model-Based Systems Engineering (MBSE) to design, synthesise and validate mission-critical systems for Smart Factories in Industry 4.0. In particular, it utilises Digital Twins to support system-level design, emulate complex system dynamics and evaluate overall system performance, prior to constructing Physical Twins. This process reduces design iterations and helps to deliver higher levels of system performance and reliability.

Intelligent Internet of Things (IoT) Systems (IIOTS)

In IIOTS, we apply core technologies such as artificial intelligence, IoT/sensors, communication technologies, cloud computing and data analytics to support Hong Kong Government's Smart City initiatives. The technologies are applied to the fields of health technology/geron-technology, education, public utilities, logistics, etc. Target deployments of the technologies developed include schools, hospitals, nursing homes, logistic companies and various government bureaus.



Intelligent Machine Vision (IMV)

Focusing on visual sensing and AI technologies, IMV deals with advanced and miniaturised optical image sensing devices as well as image understanding and deep learning algorithms. Its core technologies include automatic optical inspection (AOI) and high-precision 3D metrology, deep learning-based defect inspection and classification, industry automated AI (AAI) generation systems and small data industry AI, intelligent industry robot vision and cognition, and point-of-care (PoC) medical and healthcare image sensing.

Emerging Sensing and Display System (ESDS)

ESDS develops smart optics solutions for various applications. It focuses on AR/VR/MR for the metaverse and AR glasses for logistics and retail applications, edge AI sensing fusion systems and event-based behaviour understanding/action recognition, micro and nano optics for anti-counterfeit/data encryption/physical NFTs, and eye trackers for digital health and multifactor identification and authentication.

Sensing Devices and Integration (SDI)

SDI develops integrated optical and acoustic sensor modules for industrial, public and individual applications. The team is exploring three major technological platforms: sensing devices and modules integration for environmental sensing, hyperspectral imaging for industrial inspections, and smartphone-based spectroscopy for personal uses.

KEY TECHNOLOGIES

- AUTOMATIC OPTICS INSPECTION (AOI) FOR SURFACE DEFECT INSPECTION
- HIGH PRECISION AND HIGH SPEED 3D METROLOGY (STRUCTURE LIGHT, TRIANGULAR, CONFOCAL & OCT)
- MID-RANGE HIGH PRECISION 3D LIGHT DETECTION AND RANGING (LIDAR)
- POINT-OF-CARE (POC) MEDICAL IMAGING DEVICES
- DEEP-LEARNING-BASED SOFTWARE PLATFORM FOR DEFECT DETECTION AND CLASSIFICATION
- INTELLIGENT 2D/3D EYE-IN-HAND (EIH) VISUAL SENSING MODULE FOR INDUSTRY ROBOTS
- AUTOMATED AI GENERATION SYSTEM AND SMALL DATA AI FOR QUALITY INSPECTION & AUTOMATIC PICK-&-PLACE
- AR/VR/MR FOR THE METAVERSE AND AR GLASSES FOR LOGISTICS/RETAIL
- EDGE AI SENSING FUSION SYSTEM FOR CONSTRUCTION AND PROPERTY MANAGEMENT
- EVENT-BASED BEHAVIOUR UNDERSTANDING AND ACTION RECOGNITION
- MICRO AND NANO OPTICS FOR ANTI-COUNTERFEIT, DATA ENCRYPTION AND PHYSICAL NFTS
- EYE TRACKER FOR DIGITAL HEALTH AND MULTIFACTOR IDENTIFICATION AND AUTHENTICATION
- MOBILE SPECTROSCOPY FOR ENVIRONMENTAL SENSING AND PERSONAL EVERYDAY APPLICATIONS
- ACOUSTIC SENSOR MODULES FOR THE INSPECTION AND CLASSIFICATION OF RECYCLABLE MATERIALS
- DIGITAL AND PHYSICAL TWINS
- MODE-BASED SYSTEMS ENGINEERING
- ARTIFICIAL INTELLIGENCE
- AFFECTIVE COMPUTING
- DATA ANALYTICS
- VIDEO ANALYTICS
- IOT NETWORKS AND SENSORS

R&D HIGHLIGHT

A Digital and Physical Twins Approach to Building a Robotic Manipulation System for Manufacturing Assembly

Most manufacturing assembly processes nowadays remain highly labour-intensive, and cannot be easily reconfigured. The next generation of Smart Factory aims to deliver digitalised, interconnected industrial assets that enable the exchange of data between machines, humans, and enterprise systems, bringing greater flexibility, customisation, and efficiency to the manufacturing assembly process. This will also enable skilled workers to work closely and cooperatively with machines on value-added tasks such as making concurrent modifications and conducting online quality examinations. Two major challenges facing Smart Factory stakeholders, however, are uncertainty and reconfiguration.

In the Digital and Physical Twins approach, a manufacturing assembly process is designed, optimised and validated with the Digital Twin before its actual deployment in the Physical Twin. In this project, we are constructing a Robotic Manipulation System consisting of two Robotic Arms and one Vision System to simulate a manufacturing assembly process. The system includes a Tool Changer to provide flexibility for conducting multiple tasks with one robot arm, by switching different tools automatically. The basic assembly tasks include screwing and unscrewing, taping, rolling, inserting, picking and placing.

The process is designed, optimised and validated with the Digital Twin before its actual deployment in the Physical Twin. The Digital Twin enables collision checking and avoidance to be easily done digitally, without the risk of real physical damage. It also enables the design of the Robotic Manipulation System to be optimised using rigorous mathematical algorithms. The manufacturing process can also be easily adapted for a variety of similar products with slightly different shapes and dimensions.

R&D HIGHLIGHT

Affective Computing for Education

In recent years, the education sector has paid increasing attention to the psychological states of students and how these are linked with academic achievement. The emotions and affections of students are of particular interest, as many studies have established a relationship between positive emotions/affections and academic success, and shown that negative emotions/affections can hinder academic progress. Affective states can be an important driver of a student's academic achievements.

In this project, we are using technology to analyse the behaviour of many gifted students and identify the causes of their positive affective states. By analysing their facial expressions as well as the activities they undertake while learning, we are gaining an idea of their affective states, especially those that are crucial to academic learning, personal and professional growth, and inter-personal relationships. Of particular interest are the affective states involved in concentration, motivation, perseverance, engagement, and self-initiative. Having a better understanding of these affective states and their causes would enable the education community to cultivate them more widely in the general student population.

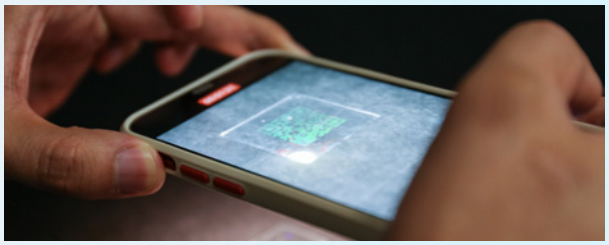
The Hong Kong Education Bureau (EDB) assists ASTRI in this research. A system for analysing students' affective states has been deployed at the Hong Kong Academy of Gifted Education, a subsidiary of the EDB, in a pilot trial.

R&D HIGHLIGHT

Flexible Diffractive Optics for Object Authentication

There is a global growing demand for object authentication and anti-counterfeiting solutions, but no one anti-counterfeit technology in the market addresses all the issues of authenticity, copy-proof, cost and user-verification, so multi-level authentication is necessary for high security.

ASTRI's flexible diffractive optics-based security label with encrypted data combines both optical and digital security for verifying documents or products and retrieving security information. The authentication QR code containing encrypted confidential and public information is protected against counterfeiting with a transparent diffractive nano structure layer that contains angular multiplexing optical features. The information can be read by a smartphone app, and the optical features can be inspected by the smartphone. This solution can be used to protect products and brands, authenticate documents, and for anti-counterfeiting for physical NFTs.



R&D HIGHLIGHT

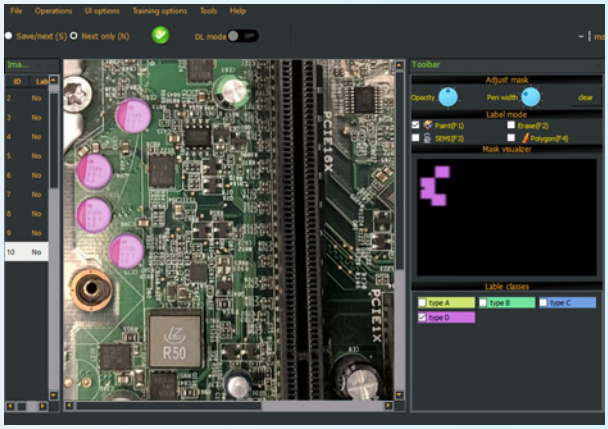
End-to-end AI-Powered Visual Inspection Platform

Winner of the 2021-22 Hong Kong Awards for Industry: Equipment and Machinery Design Award

Developing an automated inspection system using AI is a challenge for many companies. Training data has to be prepared in advance by first manually inspecting the products and marking down defect information. Machine learning engineers are needed to train the AI model with the labelled data, and conduct evaluations until the AI model performs satisfactorily. This involves relatively long-term costs, and most importantly, relies on having machine learning experts available, which some companies find difficult due to the shortage of qualified personnel.

This intelligent vision-based platform provides an end-to-end solution for the development and evaluation of an AI inspection model. Utilising deep learning techniques (including classification, object detection and segmentation), it enables users without specialist AI knowledge to collect data semi-automatically, train the deep-learning-based inspection models, and deploy the trained models to the production line for 24/7 online inspection with simple UI. There are no limitations to the kinds of components or production stages that can be inspected as long as defective images are provided with the correct labels. As a drop-in software, it does not require any modification to existing machinery, and can therefore be quickly and easily adopted on new or existing production lines.

This platform has been successfully deployed in numerous production lines, where it is assisting companies, including SMEs experiencing difficulties in competing for talent with large suppliers, to improve their production quality and accelerate their transformation and upgrading process using advanced AI technologies.



R&D HIGHLIGHT

Noise Recognition Platform with Decentralised AI for Active Noise Management

A new computing service called Industrial IoT, which uses Internet of Things (IoT) technologies to enhance industrial processes, is bringing new opportunities for industry. ASTRI's Industrial IoT project involves establishing a platform that uses edge computing devices with Artificial Intelligence to recognise and classify noises. In handling noise complaints, the current practice of the Environmental Protection Department is largely passive and complaint-based. Its system requires significant human effort, and is not responsive enough in certain time-sensitive scenarios where real-time noise monitoring is essential, such as percussive piling, excavator, etc., during unauthorised hours at construction sites. Our proposed solution is to establish a communication platform connecting edge computing devices with sensors to monitor environmental noise. This can be automated with decentralised intelligence to help monitor and classify cases when significant noise is detected.

R&D HIGHLIGHT

Edge AI Sensing Fusion System for the Construction Industry

Safety and productivity are two major concerns of the construction industry. Safety issues can cause fatal accidents and project delays, and increase production costs. The availability of manpower can be another problem. Unless signal men and safety officers are available on-site at all times, supervisors do not have access to accurate real-time information about site activity.

ASTRI's Edge AI sensing fusion system addresses these issues by leveraging edge computing, deep learning, and object detection with vision-based sensing technology. The system, which provides cost-effective real-time construction site monitoring, supports up to eight cameras simultaneously, providing blind spot-free surround sensing with high quality functionality in video analytics and recording. It is not only helping prevent accidents at construction sites but also increasing productivity and efficiency.

R&D HIGHLIGHT

Visual Content Search Platform with Transfer Learning for Smart Police

This project is developing a visual content search platform for the Hong Kong Police Force (HKPF).

Since 2012, the Police Public Relations Branch (PPRB) has produced hundreds of thousands of media files to enhance communication with the public. At times, the PPRB needs to extract relevant information from these archived media files, a process involving human inspection that requires a great deal of resources in terms of labour and time.

This Visual Content Search Platform aims to increase the capacity and efficiency of the PPRB in locating visual content in media files. HKPF is providing the media data needed for machine learning. The project team will build and train an artificial intelligence model using a Deep Convolutional Neural Network (DCNN). The model will be able to locate different classes of visual object, and use the extracted object feature descriptors to locate the exact object required. A pilot run trial will be deployed by the PPRB.

Microscopic Hyperspectral Imaging (MHSI)

The emerging technology of microscopic hyperspectral imaging is proving useful for food and forensic inspections, enabling microscopes with both spectral and spatial resolutions to go well beyond what human vision can detect. Microscopic hyperspectral imaging is a particularly powerful tool for locating plastic microbeads, for environmental protection and food safety purposes. Every year, more than 10 million tons of plastic waste end up in the oceans as microbeads, i.e. tiny plastic particles typically no larger than a few microns. These eventually get into our foods, and can induce cancer and infertility. Having a proper tool to monitor this kind of plastic pollution in the environment, and in our foods, is essential.

Conventional microscope-based Raman and fluorescence mapping devices are commercially available as high-end equipment for microscopic hyperspectral imaging, but they are bulky and expensive and, when operating in point-scan mode, slow. This project is developing a portable and affordable microscopic hyperspectral imaging device that operates in line-scan mode, with enhanced resonance laser illumination. This will make it possible to investigate the particle sizes and the chemical compositions of plastic microbeads in water and in food, on site and in real time.

OTHER R&D PROJECTS

PROJECT	FOCUS
Flexible Display Inspection System (FDIS)	Re-industrialisation and Intelligent Manufacturing
Smart Visual Recognition for e-Armory Management	Smart City
Small Data AI for Smart Manufacturing – Quality Inspection	Re-industrialisation and Intelligent Manufacturing
Metalens Design for Mobile 3D Sensing	Smart City
Automated AI Generation System for Smart Manufacturing	Re-industrialisation and Intelligent Manufacturing
High-Precision Mid-Range 3D Sensing Platform	Smart City
Multi-Factor Human Centric Sensing Fusion	Smart City
Fast Motion And Static Status Analysis With Dynamic Vision Sensing	Smart City
Pantoscopic Optical System For Wearable Medical Display	Smart City
Portable Remote-gas-sensing Device for Firefighters	Smart City
Embedded Smartphone Spectrometer (SPS2)	Smart City
Multispectral Acoustic Sensor for On-Site Plastic Sorting (MAcoust)	Smart City
Adopting the Digital and Physical Twins Approach for the Realisation of Robotic Manipulation System for Manufacturing Assembly Process	Re-industrialisation and Intelligent Manufacturing
Advanced Collaborative Mobile Manipulator for 3D Navigation and Manipulation	Re-industrialisation and Intelligent Manufacturing
A Hong Kong Smart Water Metering Communication Standard and Reference Design	Smart City
Intelligent Platform for Fleet Operations	Smart City
Digitalised Elderly Services Platform	Digital Health
Detainee Mood Status Alert System	Digital Health
Trial: Enhancing Facility Management Security Through IoT and Smart Analytics	Smart City
Automation System for Water Quality Monitoring	Smart City
Flood Monitoring and Forecasting with Intelligent LoRaMesh Networking and Machine Learning Methods	Smart City

ENGAGING WITH THE COMMUNITY

KEY VISITS TO THE ATC DURING FY 2021/2022

China Resources Enterprises, Limited
11 January 2022

Esquel Group
26 January 2022

Bonjour Holdings Limited
30 December 2021

Financial Services and the Treasury Bureau
29 December 2021

Hong Kong Opto-Mechatronics Industries Association
3 December 2021

Drainage Services Department
30 November 2021

Hong Kong CPPCC Youth Association

9 September 2021

The Chinese Manufacturers' Association of Hong Kong

6 August 2021

CLP Holdings Limited

4 August 2021

The British Consulate-General Hong Kong

5 August 2021

Liaison Office of the Central People's Government in the Hong Kong S.A.R. (LOCPG) Delegation

31 July 2021

Chinese General Chamber of Commerce

27 July 2021

Chinese Banking Association of Hong Kong

5 July 2021

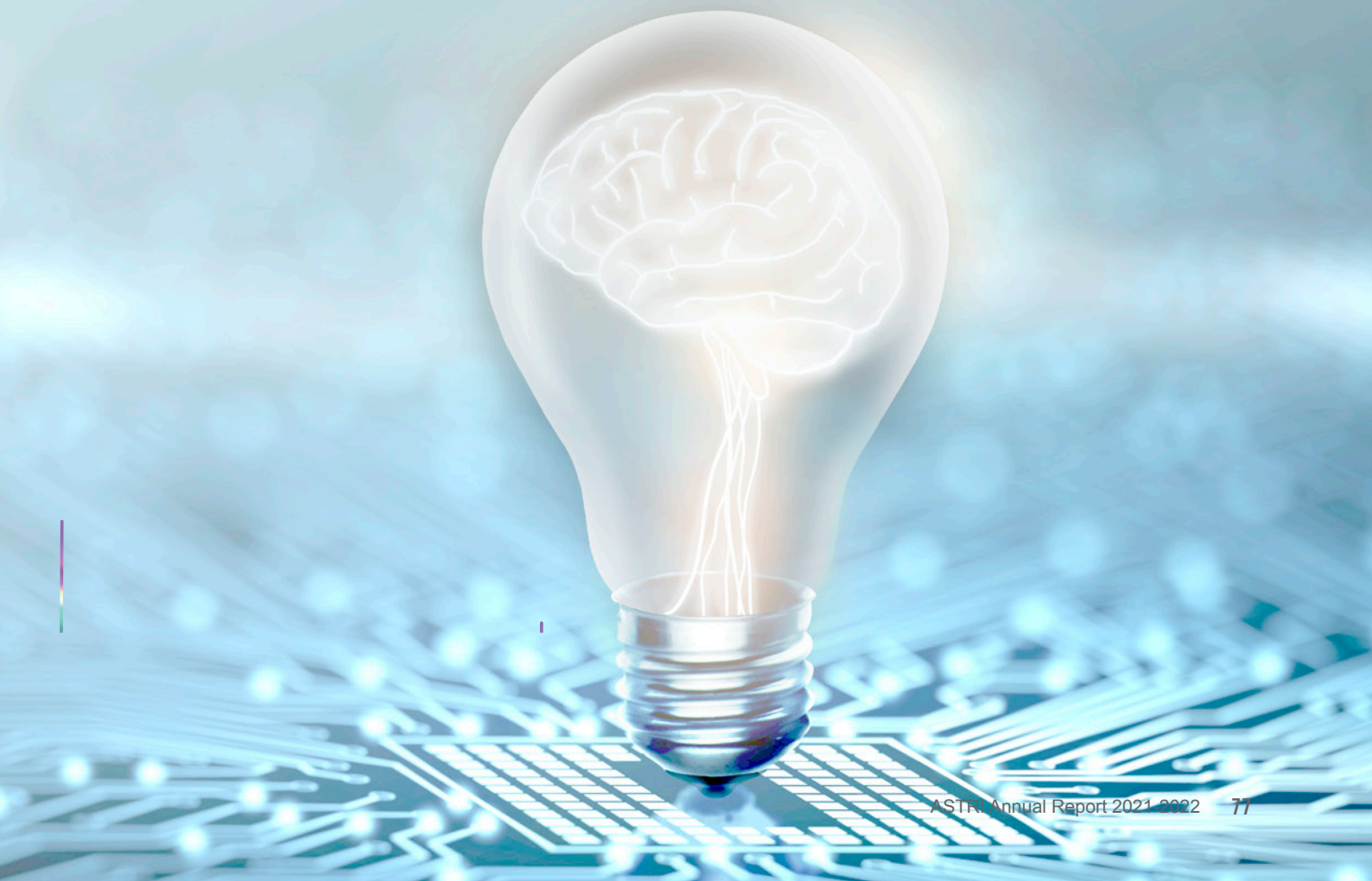
TALENT INITIATIVES

By identifying talent, training a skilled technology workforce, and partnering with academia and industry, ASTRI performs the role of a "partnership architect" for the I&T ecosystem. To this end, ASTRI has launched a series of diversified initiatives designed to attract, nurture and retain talent, and enlarge the I&T talent pool.

FIRST-OF-A-KIND "TOP TECHNOLOGY SCHOLAR PROGRAMME" LAUNCHED, OFFERING A PROMOTION PLAN AND SCHOLARSHIPS TO ADVANCED DEGREE HOLDERS

In March 2022, ASTRI launched a new "Top Technology Scholar Programme" to attract recent Master's and PhD degree graduates. Participants will get to engage in important ASTRI research projects and gain experience related to the GBA. Those who achieve their performance targets for the first year will be promoted and awarded a pay rise, and those completing the two-year programme will be awarded scholarships.

The programme is open to local and non-local talents who have graduated from graduate schools within the previous two years. Candidates will benefit from ASTRI's R&D collaboration with many enterprises and institutions in the GBA, with opportunities to visit industry giants in the area. Participants will also have opportunities to visit start-ups and learn more about their business models. If the epidemic situation allows, ASTRI will arrange for participants to travel overseas for training and knowledge exchanges.



FINTECH FUTURE LEADER ACADEMY ESTABLISHED TO CULTIVATE I&T TALENT WITH INDUSTRY PARTNERS

In January 2022, ASTRI established the FinTech Future Leader Academy, with a programme designed exclusively for undergraduates in their second or third year, or postgraduates, in relevant disciplines including I&T and Business. The Academy offers participants opportunities to work as an intern at ASTRI, where they can view FinTech development up close and gain insights into the FinTech industry. They will also be offered field visits to the programme's nine supporting organisations, namely Bank of China (Hong Kong), China Life (Overseas), Cyberport, Hewlett Packard Enterprise, the Hong Kong Monetary Authority, the Hong Kong Science and Technology Parks Corporation, IBM, Microsoft Hong Kong, and Ping An OneConnect Bank.

Students on the programme will undertake an eight-week internship in ASTRI from June to August 2022, overseen by ASTRI experts. They will have the opportunity to take part in different FinTech R&D projects, including projects relating to the issuance of Central Bank Digital Currencies, the use of Federated Learning technology to promote alternative credit assessment, and the application of Artificial Intelligence to the analysis of Environmental, Social and Governance (ESG) reports. During the internship period, students will also undertake two-week field visits to any of the nine well-known institutions supporting the programme, where they will learn from industry professionals about how FinTech is impacting our society.

NURTURING A FINTECH TALENT PIPELINE FOR HONG KONG

The FinTech Career Accelerator Scheme (FCAS) was set up in 2016 to nurture Hong Kong's financial and technological talents and help to meet the evolving needs of the financial services industry. ASTRI is a co-organiser of this scheme, spearheaded by the Hong Kong Monetary Authority, along with Hong Kong Cyberport and the Hong Kong Science Park. FCAS participants go through a year- long programme of technical and regulatory training, along with internship placements in Hong Kong and Shenzhen and a gap-year industry placement. More than 500 students from local universities have benefited from the programme since its first launch.

ASTRI CONTRIBUTES TO THE CLAP-TECH PATHWAY INITIATIVE

ASTRI has joined hands with Hong Kong Baptist University in the CLAP-TECH Pathway Initiative, which provides mentorship programmes for secondary school students throughout their entire school journey. In our session, we have welcomed student groups on visits to the ASTRI Technovation Centre, where our technologists have demonstrated some of ASTRI's most exciting innovations (including C-V2X, AI Chatbot, OCR technology, AR/VR and Optical Spectroscopy) and introduced potential career paths. Many students have been inspired by these engaging tech tours. The CLAP-TECH Pathway, funded by The Hong Kong Jockey Club Charities Trust, is a five-year educational initiative that incorporates career and life development in its curriculum, with a special emphasis on developing ICT knowledge and essential workplace skills.

HONG KONG RED SWASTIKA SOCIETY TAI PO SECONDARY SCHOOL

DELIA MEMORIAL SCHOOL (HIP WO)

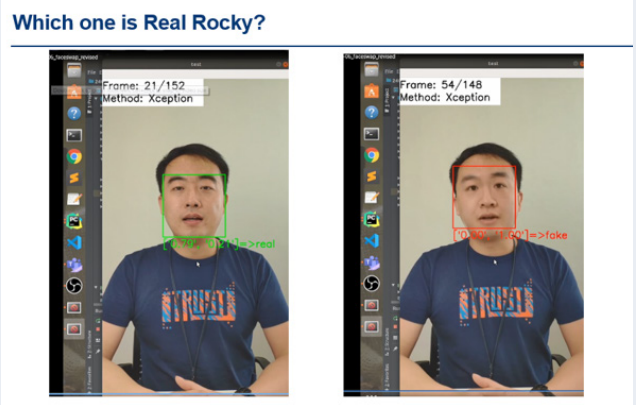
ASTRI AND THE HONG KONG ACADEMY FOR GIFTED EDUCATION (HKAGE)

In May 2021, ASTRI and the Hong Kong Academy for Gifted Education (HKAGE), which provides structured support to gifted students, jointly organised a "Technovation Talks" for primary and secondary school students. The series gave student participants experience in R&D and knowledge-sharing opportunities. The collaboration reflects the fact that ASTRI and HKAGE share a similar mission – nurturing talent and providing young people with exceptional learning opportunities.

ASTRI X HKAGE TECHNOVATION TALKS

TALK 1: Promoting Smart Mobility: C-V2X Development

TALK 2 (Online only): Financial Technology, Data Science, Cybersecurity and Privacy



TALK 3: Third Generation Semiconductors and Smart Energy Catalyse the Advancement of Smart City

TALK 4: Igniting Dream

TALK 5: Intelligent Manufacturing: Automation and Defect Inspection

TALK 6: Digital Health: Gerontech and Cervical Cancer Screening Management System

TALK 7: Smart Government and Smart Living: Smart Water Metering Platform and Application of Big Data Analytics

TALK 8: The Digital Assets: Non-Fungible Token and Central Bank Digital Currency

KEY PERFORMANCE INDICATORS

LEVEL OF INDUSTRY INCOME	2021-2022 TARGET	2021-2022 ACTUAL
Industry Contribution (HK$ Million)	110.96	78.78[1]
Industry Income (HK$ Million)	17.10	43.34
Level of Income Received from the Industry[2]	35.5%	50.4%
R&D PROJECTS		
Number of ongoing R&D Projects as at end of the reporting period	71	76
Number of ongoing R&D projects as at end of the reporting period involving industry participation	42	39[1]
Number of companies participating in these ongoing R&D projects	101	90[1]
UTILISATION OF RESEARCH OUTPUT OF ITF-FUNDED R&D PROJECTS		
Number of licensing agreements signed	23	16[3]
Number of contract research projects undertaken[4]	58	43[3]
PUBLIC SECTOR TRIAL PROJECTS		
Number of ongoing public sector trial projects as at end of the reporting period	1	2
Number of organisations benefitting from these public sector trial projects[5]	1	7
OTHER PERFORMANCE INDICATORS		
Number of patents filed (no. of inventions)	66 (33)	67 (33)[6]
Number of patents granted	55	59
Number of academic / industry awards received	N.A.	23[7]

1 4 approved platform projects cannot be commenced in FY 2021/22 due to having taken longer time to sign the industry sponsors and lack of manpower resources for project commencement, resulting in realising the pledged industry contribution of $20.55M in FY 2022/23 instead of FY 2021/22. Besides, 3 PRP projects took longer for preparation for vetting, resulting in late submission to ITC. The pledged industry contribution of $7.71M for the 3 PRP projects will be realised in FY 2022/23.

2 Level of income received from the industry (%)

$$\frac{\text{(1) INDUSTRY CONTRIBUTION PLEDGED ^ + (2) OTHER SOURCE OF FINANCIAL CONTRIBUTION PLEDGED^ + (3) COMMERCIALISATION INCOME RECEIVED*}}{\text{(4) APPROVE PROJECT EXPENDITURE ^}} \times 100\%$$

* Commercialisation income received refers to income arising from licensing, contract services, royalties and others (e.g. sale of IPs etc.) but excluding income arising from public sector trial projects, seed projects and public sector platform projects with sponsorship waived by CIT.

^ Excluding public sector trial projects, seed projects and public sector platform projects with sponsorship waived by CIT.

3 The economic uncertainties affected research-related activities and behaviour which resulted in a decline in signing licensing agreements and contract services by 23% as comparted to FY 2020-21.

4 Refers to projects in which a company pays the full costs of the project.

5 Refers to the number of public sector organisations involved in trials under on-going and completed public sector trial projects during the year.

6 Eight patents were granted and 33 were filed in HK in FY2021-22.

7 The 23 awards consisted of (i) two awards from the PT Expo China, for “Best Innovative Technology Application Case” and “Best Booth Design Award”; (ii) one award from “Innovation China” 100 Global Best Practices for Technology Transfer 2021, for Best Cross-border Platform on Commercialisation of Innovation and Technology; (iii) one award from the 2020 State Scientific and Technological Progress Award; (iv) two awards from the ICT Awards; (v) one award from the 2021 Communications Association of Hong Kong STAR Award; (vi) four awards from the Hong Kong Awards for Industries; and (vii) 12 awards from the International Exhibition of Inventions of Geneva.

FINANCIAL REPORT

OVERVIEW

For 2021-22 financial year, the consolidated income and expenditure of ASTRI amounted to HK$544,723,717 and HK$549,460,080 respectively, resulting in a deficit of HK$4,736,363.

The funds from the Government comprised HK$165,785,565 from recurrent subvention, HK$15,615,060 from Innovation and Techonology Fund ("ITF") for reimbursement of administrative overheads, HK$250,097,768 from ITF project funds, HK$1,502,709 from ITF General Support Programme ("GSP"), HK$6,269,359 from ITF Public Sector Trial Scheme ("PSTS"), HK$19,648,272 from ITF Research Talent Hub and HK$9,341,949 from ITF for Chinese National Engineering Research Centre for Application Specific Integrated Circuit System (Hong Kong Branch). In 2021-22 financial year, the income from the industry amounted to HK$74,869,659. The total administrative expenses amounted to HK$189,019,789 (comprised of administrative expenses of HK$188,366,691 and finance cost of HK$264,312 under subvention and administrative expenses of HK$388,786 funded by accumulated surplus from other income), which represented a decrease of HK$3,024,444 (2%) compared with the previous year.

ASTRI's operation remained steady with prudent financial management throughout the year. The total expenditure of the ITF, GSP and PSTS projects amounted to HK$307,064,856, of which 74% of the expenditure was spent on manpower and 26% of the expenditure was spent on equipment, other direct costs and administrative overheads.

The total expenditure mainly represented the actual cash outflow incurred during the year for 84 full projects, 35 seed projects, two GSP projects and six PSTS projects. Meanwhile, the expenditure relating to Research Talent Hub amounted to HK$19,648,272, which represented the actual cash outflow of salary payment for research talents engaged in 37 full projects and 11 seed projects.

The consolidated financial statements of ASTRI for the year ended 31 March 2022 have been audited by independent auditors with unqualified audit opinion, an extract of the Consolidated Statement of Income and Expenditure, Consolidated Statement of Comprehensive Income and Consolidated Statement of Financial Position are set out on pages 84-86.

CONSOLIDATED STATEMENT OF INCOME AND EXPENDITURE AND COMPREHENSIVE INCOME

YEAR ENDED 31 MARCH 2022	2022 (HK$)	2021 (HK$)
SUBVENTION		
Income from Government subvention	165,785,565	171,361,547
Administrative expenses	(188,366,691)	(190,821,971)
Finance cost	(264,312)	(437,857)
Deficit on subvention	(22,845,438)	(19,898,281)
FUNDING SUPPORT FROM INNOVATION AND TECHNOLOGY FUND		
Reimbursement of administrative overheads	15,615,060	7,869,402
	(7,230,378)	(12,028,879)
PROJECT FUNDING FROM INNOVATION AND TECHNOLOGY FUND AND INDUSTRY CONTRIBUTIONS		
PROJECT FUND INCOME		
- Innovation and Technology Fund	250,097,768	227,532,108
- Industry contributions	48,588,832	82,317,235
Project expenditure	(298,686,600)	(309,849,343)
Balance on project funding	-	-
PROJECT FUND INCOME - GENERAL SUPPORT PROGRAMME		
- Innovation and Technology Fund	1,502,709	1,735,224
- Industry contributions	606,188	1,200,000
Project expenditure	(2,108,897)	(2,935,224)
Balance on project funding	-	-
PROJECT FUND INCOME - PUBLIC SECTOR TRIAL SCHEME		
- Innovation and Technology Fund	6,269,359	15,955,768
Project expenditure	(6,269,359)	(15,955,768)
Balance on project funding	-	-
PROJECT FUND INCOME - RESEARCH TALENT HUB		
- Innovation and Technology Fund	19,648,272	25,297,240
Project expenditure	(19,648,272)	(25,297,240)
Balance on project funding	-	-
PROJECT FUNDING FROM MINISTRY OF SCIENCE AND TECHNOLOGY OF THE PEOPLE'S REPUBLIC OF CHINA		
Project fund income	-	23,917
Project expenditure	-	(23,917)
Balance on project funding	-	-

CONSOLIDATED STATEMENT OF INCOME AND EXPENDITURE AND COMPREHENSIVE INCOME (CONTINUED)

YEAR ENDED 31 MARCH 2022	2022 (HK$)	2021 (HK$)
FUNDING SUPPORT FROM INNOVATION AND TECHNOLOGY FUND FOR CHINESE NATIONAL ENGINEERING RESEARCH CENTRE FOR APPLICATION SPECIFIC INTEGRATED CIRCUIT SYSTEM (HONG KONG BRANCH) ("CNERC-ASIC")		
Expenditure incurred in relation to Funding Support from Innovation and Technology Fund	(9,341,949)	(9,489,445)
Amount for reimbursement	9,341,949	9,489,445
	-	-
RESERVE FUND		
Reserve Fund - income	1,593,376	2,353,855
Reserve Fund - expenditure	(1,593,376)	(2,353,855)
	-	-
OTHER INCOME, NET		
Other income	25,674,639	20,249,185
Other expenses	(14,117,301)	(14,340,038)
Other income, net	11,557,338	5,909,147
AMOUNT RETURN TO THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION	**(9,073,738)**	**(2,742,012)**
DEFICIT BEFORE TAX	(4,746,778)	(8,861,744)
INCOME TAX CREDIT/(EXPENSE)	10,415	(18,672)
DEFICIT FOR THE YEAR	**(4,736,363)**	**(8,880,416)**
OTHER COMPREHENSIVE INCOME THAT MAY BE RECLASSIFIED TO SURPLUS OR DEFICIT IN SUBSEQUENT PERIODS		
Exchange differences arising on translation of foreign operations	**32,709**	**71,916**
TOTAL COMPREHENSIVE DEFICIT FOR THE YEAR	**(4,703,654)**	**(8,808,500)**

CONSOLIDATED STATEMENT OF FINANCIAL POSITION

31 MARCH 2022	2022 (HK$)	2021 (HK$)
NON-CURRENT ASSETS		
Property, plant and equipment	6,424,986	10,281,928
Right-of-use assets	67,457,218	20,737,117
	73,882,204	**31,019,045**
CURRENT ASSETS		
Accounts receivable, other receivables, contract assets, prepayments and deposits	17,854,099	16,350,716
Amount due from the Government of the Hong Kong Special Administrative Region	46,422,301	36,141,977
Tax recoverable	32,765	1,215,326
Cash and cash equivalents	306,476,135	352,161,228
	370,785,300	**405,869,247**
CURRENT LIABILITIES		
Accounts payable, other payables and accruals	77,221,466	88,088,316
Deferred government grants	18,695,192	11,214,830
Receipts in advance	209,518,608	240,587,452
Amount due to the Government of the Hong Kong Special Administrative Region	1,145,166	3,227,702
Lease liabilities	23,384,688	17,894,571
Tax payable	-	16,489
Provision	-	11,460,469
	329,965,120	**372,489,829**
Net Current Assets	**40,820,180**	**33,379,418**
Total Assets Less Current Liabilities	**114,702,384**	**64,398,463**
NON-CURRENT LIABILITIES		
Lease liabilities	40,852,929	609,001
Provision	14,763,647	-
	55,616,576	**609,001**
Net assets	**59,085,808**	**63,789,462**
EQUITY		
Share capital	2	2
Reserves	59,085,806	63,789,460
Total equity	**59,085,808**	**63,789,462**

Note:

These financial statements have been prepared in accordance with Hong Kong Financial Reporting Standards (which include all Hong Kong Financial Reporting Standards, Hong Kong Accounting Standards and Interpretations) issued by the Hong Kong Institute of Certified Public Accountants, accounting principles generally accepted in Hong Kong and the Hong Kong Companies Ordinance. They have been prepared under the historical cost convention and are presented in Hong Kong dollars ("HK$").

The financial information relating to the years ended 31 March 2022 and 31 March 2021, included in the Consolidated Statement of Income and Expenditure and Comprehensive Income, and the Consolidated Statement of Financial Position set out on pages 84-86, is not part of the Company's statutory consolidated financial statements for those years but is derived from them. Further information relating to those statutory financial statements required to be disclosed in accordance with section 436 of the Hong Kong Companies Ordinance is as follows:

As the Company is a private company, the Company is not required to deliver its financial statements to the Registrar of Companies and has not done so.

The Company's auditor has reported on the consolidated financial statements of the Group for both years. The auditor's reports were unqualified; did not include a reference to any matters to which the auditor drew attention by way of emphasis without qualifying its reports; and did not contain a statement under sections 406(2), 407(2) or (3) of the Hong Kong Companies Ordinance.

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