大學教育資助委員會
University Grants Committee

香港科技大學
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

TRS

THEME-BASED RESEARCH SCHEME PUBLIC SYMPOSIUM 2024

主題研究計劃研討會

8 December 2024 (Sunday)
10:00—16:15

The Hong Kong University of Science and Technology
1/F, Academic Building
Padma and Hari Harilela Lecture Theater (LT-C)
Lee Wing Tat Lecture Theater (LT-D)

2024 年 12 月 8 日 (星期日)
上午 10 時至下午 4 時 15 分

香港科技大學
學術大樓 1 樓
夏利萊博士及夫人演講廳 LT-C
利榮達演講廳 LT-D

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Welcome Message from the Research Grants Council
研究資助局歡迎辭

The Research Grants Council (RGC) warmly welcomes you to the Theme-based Research Scheme (TRS) Public Symposium 2024.

Since 2011, the TRS has been providing huge support to the academic research efforts of the University Grants Committee-funded universities on themes of strategic importance for the long-term development of Hong Kong. To date, the RGC has conducted 14 rounds of exercise, granting a total of $3.36 billion to 84 projects. Ten projects funded in the eighth and ninth rounds have been successfully completed or are approaching completion. We are delighted to have the project teams to share their achievements, novel discoveries and the impacts of their frontier research with us today, through presentations, posters display and demonstrations.

Taking this opportunity, the RGC would like to express our sincere gratitude to members of the ten project teams and their universities for their contributions to making this Symposium a success. We would also like to thank the Research Office of the Hong Kong University of Science and Technology for organising the Symposium with dedication and professionalism.

We look forward to seeing the positive impacts of these TRS projects on the social and economic development of Hong Kong.

Research Grants Council

研究資助局（研資局）熱烈歡迎各位參加 2024 年主題研究計劃研討會。

自 2011 年，主題研究計劃一直大力支持大學教育資助委員會資助大學的學術研究力量，對香港長遠發展具策略重要性的主題進行研究。至今研資局已舉行了 14 輪計劃，向 84 個獲資助項目批出合共 33.6 億元撥款。在第八及第九輪獲得撥款的十個項目已成功完成或進入最後階段。我們很高興項目團隊今天將透過講座、海報及展覽，與我們分享他們的前沿研究成果、嶄新發現及影響。

藉此機會，研資局衷心感謝十個項目的團隊成員和他們所屬的大學對是次研討會的支持，使研討會得以成功舉行。我們亦感謝香港科技大學的研發事務辦公室以充滿熱誠及專業的精神籌辦研討會。

我們期望這些主題研究計劃項目的影響，為香港的社會和經濟發展帶來裨益。

研究資助局

About the Theme-based Research Scheme
主題研究計劃概要

Theme-based Research Scheme (TRS) aims to focus academic research efforts of University Grants Committee funded universities on themes of strategic importance to the long-term development of Hong Kong.

There are four designated research themes under the TRS. Under the four research themes, there are 20 grand challenge topics:

主題研究計劃的目的是集中大學教育資助委員會資助大學的學術研究力量，對香港長遠發展具策略重要性的主題進行研究。

計劃設有四個研究主題，四個主題下共設有20個重大挑戰題目：

Theme 1: Understanding Diseases and Disease Prevention

1. Infectious Diseases
2. Understanding Disease Mechanisms to Improving Health
3. Stem Cells and Regenerative Medicine
4. Disease Prevention and Management

主題一 剖析疾病及疾病預防

1. 傳染病
2. 剖析發病機制以保障健康
3. 幹細胞與再生醫學
4. 疾病預防與管理

Theme 2: Developing a Sustainable Environment

1. Water Pollution and Water Treatment
2. Sustainable Built Environment
3. Energy Efficiency, Conservation, Conversion and Harvesting
4. Air Quality
5. Food Production and Food Security

主題二 建設可持續發展的環境

1. 水污染及水處理
2. 可持續建築環境
3. 能源效率、節約、轉化及採集
4. 空氣質素
5. 食物生產及食物安全

Theme 3: Enhancing Hong Kong's Strategic Position as a Regional and International Business Centre

1. Hong Kong's Future as an International Financial Centre
2. Promoting Hong Kong's Business through Networking Capability
3. Promoting Hong Kong as a Centre of Excellence for Business Services
4. Innovation Ecology and Business Creation in Knowledge Economy
5. Financial Technologies (FinTech) and Regulatory Technologies (RegTech)

主題三 加強香港作為地區及國際商業中心的策略地位

1. 香港作為國際金融中心的未來發展
2. 通過網絡能力推動香港商業發展
3. 推廣香港成為卓越的商業中心
4. 知識經濟中的創新生態與商業創意
5. 金融科技及監管科技

Theme 4: Advancing Emerging Research and Innovations Important to Hong Kong

1. Big Data and Artificial Intelligence
2. Imaging, Robotics and Smart Manufacturing
3. Urban Infrastructure and Smart City
4. Education and Digital Citizenship
5. Quantum Technology
6. Integrated Circuits

主題四 促進對香港起重要作用的新興研究及創新項目

1. 大數據及人工智能
2. 造像、機械人技術及智能製造
3. 城市基礎建設及智慧城市
4. 教育及數碼公民身分
5. 量子技術
6. 集成電路

The maximum duration of a project is five years. The ceiling of direct project cost per project to be awarded by the Research Grants Council is $75 million.

每個項目的年期最長為五年，研究資助局資助金額上限為 7 千 5 百萬元（按直接項目成本計算）。

Programme

Time	Programme	
9:45 – 10:00	**Registration**	
10:00 – 10:10	**Opening Ceremony (Opening Speech by Chairman of Research Grants Council)** Professor Timothy W. TONG, SBS, JP	
10:10 – 10:30	**Plenary Session –** **Funding Mechanism of the Theme-based Research Scheme** **(by Chairman of Collaborative Research Projects Steering Committee)** Professor Paul KL YU	
	Presentation Sessions	
	Venue: LT-C	**Venue: LT-D**
10:30 – 11:15	Theme 1 - Understanding Diseases and Disease Prevention THEME 1 (A1) **A Stem Cell Approach to Dissect the Molecular Basis of Neurodegenerative Diseases** Professor Nancy IP (to be presented by the Deputy Project Coordinator, Professor Zhenguo WU) The Hong Kong University of Science and Technology	Theme 2 - Developing a Sustainable Environment THEME 2 (B1) **Sustainable Marine Infrastructure Enabled by the Innovative Use of Seawater Sea-Sand Concrete and Fibre-Reinforced Polymer Composites** Professor Tao YU The Hong Kong Polytechnic University
11:15 – 11:30	**Tea Break**	
11:30 – 12:15	THEME 1 (A2) **Potentiating Host Immunity for HIV-1 Functional Cure** Professor Zhiwei CHEN The University of Hong Kong	THEME 2 (B2) **A Paradigm-shifting, Fully-integrated, Compact Wastewater-to-resource Facility (WWRF)** Professor Guanghao CHEN The Hong Kong University of Science and Technology
12:15 – 13:45	**Lunch Break**	
13:45 – 14:30	THEME 1 (A3) **Control of Influenza: Individual and Population Immunity** Professor Benjamin John COWLING The University of Hong Kong	THEME 2 (B3) **SureFire: Smart Urban Resilience and Firefighting** Professor Asif Sohail USMANI The Hong Kong Polytechnic University
14:30 – 15:15	THEME 1 (A4) **Fighting Disease Recurrence and Promoting Tissue Repair after Liver Transplantation: Translating Basic Discoveries to Clinical Excellence** Professor Nancy Kwan MAN The University of Hong Kong	Theme 4 - Advancing Emerging Research and Innovations Important to Hong Kong THEME 4 (B4) **Image-guided Automatic Robotic Surgery** Professor Yunhui LIU The Chinese University of Hong Kong
15:15 – 15:30	**Tea Break**	
15:30 – 16:15	Theme 3 - Enhancing Hong Kong's Strategic Position as a Regional and International Business Centre THEME 3 (A5) **Contributing to the Development of Hong Kong into a Global Fintech Hub** Professor Kar Yan TAM The Hong Kong University of Science and Technology	THEME 4 (B5) **Research and Development of Artificial Intelligence in Extraction and Identification of Spoken Language Biomarkers for Screening and Monitoring of Neurocognitive Disorders** Professor Helen MENG The Chinese University of Hong Kong

Poster/ Video Presentation/ Model Display

Poster and video presentations, as well as model displays (if any), from the 10 project teams are showcased outside LT-C and LT-D.

*Theme-based Research Scheme projects showcased in Public Symposium 2024 are funded by the Research Grants Council in the Eighth Round (2018/19) and Ninth Round (2019/20) exercises.

研討會程序

時間	研討會程序	
9:45 – 10:00	**登記**	
10:00 – 10:10	**開幕致詞: 研究資助局主席** 唐偉章教授, SBS, JP	
10:10 – 10:30	**主題研究計劃撥款機制簡介: 協作研究項目督導委員會主席** 余玒離教授	
	專題演講	
	地點: 演講廳 LT-C	**地點: 演講廳 LT-D**
10:30 – 11:15	主題一　剖析疾病及疾病預防 主題一 (A1) **以幹細胞方法解析神經退行性疾病的分子基礎** 葉玉如教授 (由副項目統籌人鄔振國教授代爲演講) 香港科技大學	主題二　建設可持續發展的環境 主題二 (B1) **基於海水海砂混凝土與纖維增強複合材料的新型可持續海洋工程結構** 余濤教授 香港理工大學
11:15 – 11:30	**茶 歇**	
11:30 – 12:15	主題一 (A2) **增強宿主免疫實現HIV-1功能性治癒** 陳志偉教授 香港大學	主題二 (B2) **未來污水淨化與資源回收一體化工場 (未來水工場)** 陳光浩教授 香港科技大學
12:15 – 13:45	**午 膳**	
13:45 – 14:30	主題一 (A3) **流感控制：個人和群體免疫力** 高本恩教授 香港大學	主題二 (B3) **SureFire: 智慧城市災害防控和火災應急研究** Asif Sohail USMANI教授 香港理工大學
14:30 – 15:15	主題一 (A4) **肝移植後原發病復發和組織修復的科研攻堅：從轉化基礎研究到優化臨床決策** 萬鈞教授 香港大學	主題四　促進對香港起重要作用的新興研究及創新項目 主題四 (B4) **視覺導航自動機械人手術** 劉雲輝教授 香港中文大學
15:15 – 15:30	**茶 歇**	
15:30 – 16:15	主題三　加強香港作為地區及國際商業中心的策略地位 主題三 (A5) **促進香港成為全球的金融科技樞紐** 譚嘉因教授 香港科技大學	主題四 (B5) **以人工智能提取和鑑定口語生物標誌物供神經認知障礙篩查和監測的研究及技術開發** 蒙美玲教授 香港中文大學

海報展覽、介紹影片及模型展示
有關十個項目的海報展覽、介紹影片及模型 (如有) 於LT-C 及LT-D外展示。

*本研討會所有研究項目均為研究資助局在第八輪 (2018/19年度) 和第九輪 (2019/20年度) 主題研究計劃撥款資助的項目。

A Stem Cell Approach to Dissect the Molecular Basis of Neurodegenerative Diseases

以幹細胞方法解析神經退行性疾病的分子基礎

T13-605/18-W

Project Coordinator
Professor Nancy IP
The Hong Kong University of Science and Technology

Participating Institutions
City University of Hong Kong
The Chinese University of Hong Kong
The University of Hong Kong

項目統籌人
葉玉如教授
香港科技大學

參與院校
香港城市大學
香港中文大學
香港大學

Short Biography of Project Coordinator

Professor Nancy Ip received her PhD degree in Pharmacology from Harvard University, after which she held the position of Senior Staff Scientist at Regeneron Pharmaceuticals Inc. in New York. Professor Ip joined HKUST in 1993 and is currently The Morningside Professor of Life Science and Chair Professor in the Division of Life Science. She is internationally renowned for her significant contributions to the field of neuroscience, particularly in understanding the complex mechanisms that underlie proper brain functions and in drug discovery for neurodegenerative diseases. Her outstanding research has resulted in more than 330 scientific papers and over 70 patents. She was elected as Fellows of the Chinese Academy of Sciences, the US National Academy of Sciences, and the American Academy of Arts and Sciences, among other academies, and is a recipient of numerous awards and honors, including the National Natural Science Awards and the L'OREAL-UNESCO for Women in Science Award.

項目統籌人簡介

葉玉如教授於美國哈佛大學獲藥理學博士學位，其後在紐約 Regeneron 製藥公司擔任高級科學家。她於 1993 年起受聘於科大，現任晨興生命科學教授及生命科學部講座教授。葉教授是國際知名學者，在解析大腦功能的複雜機制以及研發神經退化性疾病新藥方面有重大貢獻，發表了超過 330 篇論文和綜述，擁有 70 多項科技發明專利。葉教授還當選為多間學術機構的院士，包括中國科學院、美國國家科學院、美國人文與科學院，並獲頒多個國內外重要學術獎項，包括國家自然科學獎、歐萊雅聯合國教科文組織「世界傑出女科學家成就獎」。

Project Summary

Mission: Address the urgent need for new and innovative therapies that can treat age-related neurodegenerative disorders.

Goal: Use human induced pluripotent stem cell (iPSC) and genome-editing technologies to investigate the pathological mechanism of Alzheimer's disease (AD).

Objectives:
- Establish a human iPSC core for in vitro modeling and functional studies.
- Examine how genetic variants contribute to AD.
- Perform drug screening and preclinical drug development using iPSC-derived platforms and established animal models.

Deliverables:
- Identify and elucidate the molecular pathways that contribute to AD pathogenesis.
- Use genome-editing technologies to introduce or correct specific mutations in iPSCs.
- Identify potential molecular targets for therapeutic intervention of AD.

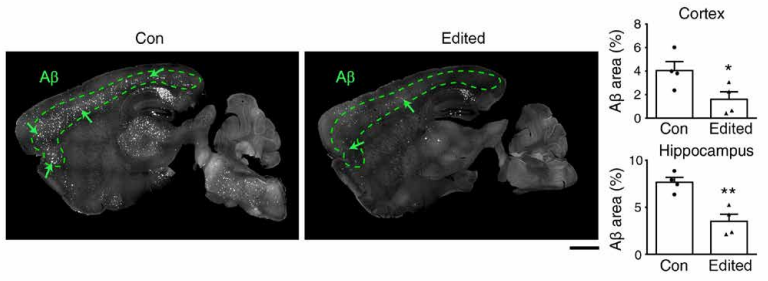
項目概要

使命： 聚焦老齡相關的神經退行性疾病，探尋創新療法以應對迫切需求。

目標： 利用人源誘導多能幹細胞（iPSC）和基因編輯技術，研究阿茲海默症 (AD) 的病理機制。

目的：
- 建立人源 iPSC 核心平臺，進行體外建模和功能研究。
- 研究遺傳變異如何導致 AD。
- 使用 iPSC 衍生平臺和動物模型進行藥物篩選和臨床前藥物開發。

成果：
- 辨識及闡明 AD 致病機制的分子途徑。
- 利用基因組編輯技術引入或修正 iPSC 中的特定突變。
- 辨識治療 AD 的潛在分子靶點。



The level of amyloid plaque deposition (white shades in area encircled by green dotted lines), a pathological hallmark of AD, is high in the brain of AD mouse (left) and decreases after the application of the genome editing therapy throughout the brain (right).
AD小鼠大腦（左圖）中有大量澱粉樣斑塊沉積，這是AD最主要的病理性標誌物（綠色虛線區域中的白色陰影）。經過基因編輯治療後，白色陰影明顯下降（右圖）。

First Members' Meeting held on 12 Dec 2018 首次會員大會於2018年12月12日召開

Abstract

This project represents our continuing effort to address the urgent need for new and innovative therapies that can treat age-related neurodegenerative disorders, such as the highly prevalent and devastating AD. We have established the capability and platforms for iPSC differentiation into specific brain cell types and brain organoids. The current project builds upon these findings and further explores the pathological mechanism of AD using innovative approaches that harness advanced stem cell and genome-editing technologies. With these technologies, we have succeeded in generating and utilizing patient-derived iPSCs that carry genetic risk variants for AD to conduct detailed investigations on the disease pathophysiology. The establishment of the iPSC-derived neuronal platform provides a useful tool to evaluate the efficacy and safety of drug candidates on human neurons. Furthermore, we have developed a novel strategy using brain-wide genome-editing technology that can reduce AD pathologies in genetically modified AD mouse models. This advanced technology has garnered significant attention and awards, including the 2021 "Major Breakthrough in Neuroscience" award from the Chinese Neuroscience Society and a Gold Medal at the 49th International Exhibition of Inventions Geneva, for its potential to be translated into a novel long-acting therapeutic treatment for AD patients. It is among the first selected for the "Research, Academic, and Industry Sectors One-plus (RAISe+) Scheme" by the Innovation and Technology Commission of the HKSAR Government.

項目簡介

我們持續努力探尋創新療法應對與老齡相關的神經退化性疾病，例如嚴重威脅人們健康的高發病 AD，以滿足迫切的需要。我們建立了平臺，能將 iPSC 分化成特定腦細胞類型和產生腦類器官。本項目在此基礎上，利用先進的幹細胞和基因組編輯技術進一步探索 AD 的病理機制。我們建立了源自攜帶 AD 遺傳風險變異患者的 iPSC，藉此深入研究病理生理學。這些 iPSC 衍生的神經元，亦可用作評估候選藥物的功效和安全性。此外，我們成功研發出一種新型全腦基因編輯技術，在小鼠模型中證明可以改善 AD 的病理症狀，有潛力發展成爲 AD 的新型長效治療手段。該技術獲得了中國神經科學學會 2021 年度「神經科學重大進展」殊榮，在第四十九屆日內瓦國際發明展上取得金獎，並成為首批獲創新科技署「產學研 1+ 計劃」(RAISe+) 資助的項目之一。

Research Impact

We have succeeded in developing advanced capabilities and generating valuable data towards establishing groundwork to develop novel therapies to treat incurable neurological diseases, such as AD, and hence addressing critical unmet medical needs and easing the associated financial burdens. In the long run, these newly established advanced capabilities and technologies will drive research excellence at local institutions, increase collaborations with mainland China and international institutes, provide training opportunities for young scientists, place Hong Kong on the map for advanced neural regenerative medicine and stem cell research, and will ultimately strengthen Hong Kong's position as an international innovation and technology centre.

研究影響

我們擁有先進的研究能力並取得重要數據，為治理 AD 等無法治癒的神經系統疾病提供了理論基礎，有助應對醫療需求缺口及減輕相關的經濟重擔。長遠而言，這些先進的科研能力和技術將有助推動本港卓越研究，加強與內地和國際機構的合作，為年輕科學家提供培訓機會，讓香港在先進神經再生醫學和幹細胞研究領域居前，鞏固香港作為國際創新科技中心的地位。

Fourth Annual Symposium held on 09 Jan 2024 第四屆年度研討會於2024年1月9日舉行

Potentiating Host Immunity for HIV-1 Functional Cure

增強宿主免疫實現HIV-1功能性治癒

T11-706/18-N

Project Coordinator
Professor Zhiwei CHEN
The University of Hong Kong

Participating Institution
The Chinese University of Hong Kong

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陳志偉教授
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Short Biography of Project Coordinator

Professor Zhiwei Chen is an expert in the field of HIV/AIDS and emerging infectious diseases. He is an inventor/co-inventor of two AIDS and two COVID-19 vaccines, which have been developed from the laboratory to human phase I trials in the Mainland and Hong Kong. His invention of PD1-based DNA vaccines and bi-specific antibodies against HIV/AIDS serves the core of this project. Prof Chen has obtained many grants, including TRS, the General Research Fund, the Collaborative Research Fund, and Health and Medical Research Fund in Hong Kong, as well as international fundings from National Institutes of Health and the Bill & Melinda Gates Foundation. With his coordination, the research team generates consistently high-impact research outputs and promotes the technology transfer of the “made in Hong Kong” immunotherapeutic products for clinical development.

項目統籌人簡介

陳志偉教授是愛滋病和新興傳染病領域的專家。他是兩種愛滋病疫苗和兩種新冠肺炎疫苗的發明者 / 共同發明者。目前，這些疫苗均已在內地和香港從實驗室研發階段進階至 I 期臨床試驗階段。陳教授團隊研發的 PD-1 增強型 DNA 疫苗和雙特異性抗體是此項目的核心關鍵。陳教授獲得了多項研究基金的資助，包括香港的主題研究計劃、優配研究金、協作研究金和 醫療衞生研究金項目，以及來自美國國立衞生研究院和比爾及梅琳達蓋茲基金會的海外資助。在他的統籌下，研究團隊不僅持續產出高影響力的研究成果，並促進「香港製造」免疫療法候選藥物的技術轉移以應用於臨床。

Project Summary

To determine correlates of PD1-based vaccine and BiIA-SG- induced protection in SHIVSF162P3CN-infected rhesus macaques.

To determine immunogenicity and efficacy of GLP-grade human PD1-based vaccine and BiIA-SG in animal models in support of Investigational new drug (IND) application.

To investigate the possible functional cure of HIV-1 infection in patients by PD1-based vaccine and BiIA-SG immunotherapies.

項目概要

研究 PD-1 增強型 DNA 疫苗和雙特異性抗體在 SHIV SF162P3CN 感染的恒河猴中誘導的保護效力。

研究 GLP 級別生產的人 PD-1 增強型 DNA 疫苗和雙特異性抗體在動物模型中的免疫原性和功效，以支持新藥臨床試驗 (IND) 申請。

探討 PD-1 增強型 DNA 疫苗和雙特異性抗體免疫療法對 HIV-1 感染者功能性治癒的可能性。

The research team working in Laboratory
在實驗室工作的研究團隊

Professor Kwok-Yung Yuen visiting ICVAX clinical trial onsite
袁國勇教授現場考察指導ICVAX臨床研究

The photo of the project team 此項目的團隊合照

Abstract

HIV/AIDS has been a major health burden worldwide, with more than 39.0 million people living with HIV-1 (PLWH) currently. In Hong Kong, there are more than 11943 accumulative cases reported in total nowadays. Although combined anti-retroviral therapy (cART) is available, this life-long treatment is expensive and may cause adverse effects or drug resistance in PLWH. This TRS project aims to develop a promising immunotherapeutic strategy to suppress HIV-1 infection to undetectable viremia levels in PLWH without life-long cART.

Our research team has set up collaborations with two biomedical companies for the manufacture of Good Laboratory Practice/ Good Manufacturing Practice (GLP/GMP)-graded PD-1-based DNA vaccine (ICVAX vaccine) and bi-specific antibody (BiIA-SG). The preventive or protective efficacies against AIDS, as well as their underlying mechanisms, were tested in the SHIV-infected rhesus macaque model. Collectively, both immunotherapeutic strategies work efficiently and effectively in prophylactic administration at the pre-exposure and/or post-exposure of viral infection. After obtaining various approvals of GMP, IND, research ethics, etc., we successfully brought the ICVAX vaccine into Phase I clinical trial. Our 5-year TRS project illustrated the translational process of our scientific discoveries into clinical development. It leads a promising “made in Hong Kong” immunotherapeutic candidate to the future hope of local and international AIDS communities.

Research Impact

Our overall objective is to potentiate host immunity to achieve a functional cure for HIV-1 infection, a status of suppressed viremia below the limit of detection, for benefiting PLWH without receiving ART. First, our research team successfully brought the ICVAX vaccine into Phase I clinical trial and illustrated the translational process and the underlying mechanisms of our scientific discoveries into clinical development step by step. It leads to a promising “made in Hong Kong” immunotherapeutic candidate for the functional cure of AIDS. Second, by establishing a Hong Kong consortium of outstanding scientists and biomedical R&D companies, we generated GLP/GMP-grade vaccines or antibodies for preclinical and clinical studies. We also developed the PD-1-based vaccination platform not only in the field of HIV/AIDS, but also in other diseases such as COVID-19 and cancer with 2 patents granted and 1 patent filed. Third, we generated 20 peer-reviewed publications in leading scientific journals and 17 international conference papers during this project period. Moreover, we have obtained research grants from other sources to work on 4 new projects, which evolved directly from this TRS project. These projects further promote our future biomedical research and drug development in the area of infectious diseases.

項目簡介

愛滋病是全球公共健康的主要難題之一，目前有超過 3,900 萬愛滋病病毒感染者（PLWH）。香港目前累計報告個案超過 11943 例。儘管 PLWH 可以使用聯合抗逆轉錄病毒療法（cART），但這種終生治療價格昂貴，並且可能導致 PLWH 產生不良反應或抗藥性。此 TRS 項目旨在研發一種有前景的免疫治療策略，將 PLWH 的病毒感染抑制至不可檢測的病毒血症水平，並且無需終身服用 cART。

研究團隊與兩家生物醫藥公司建立合作，生產 GLP/GMP 級別的 PD-1 增強型 DNA 疫苗（ICVAX 疫苗）和雙特異性抗體（BiIA-SG），在感染 SHIV 的恒河猴模型中檢測了兩者對愛滋病的預防或保護效力及其相關機制。總體而言，兩種免疫治療策略在病毒感染暴露前和 / 或暴露後的預防性給藥中均有效且效果顯著。在獲得 GMP、IND、科研倫理等多個委員會核准後，我們最終成功將 ICVAX 疫苗推進至 I 期臨床試驗。此項為期 5 年的 TRS 項目也展示出我們將科學發現轉化至臨床試驗的過程。ICVAX 疫苗未來有望成為「香港製造」的免疫治療候選藥物，為本地和國際愛滋病病人帶來希望。

研究影響

研究團隊的整體目標是透過增強宿主免疫以實現愛滋病病毒感染者（PLWH）的功能性治癒，從而使 PLWH 在不接受 ART 的情況下實現病毒血症抑制至檢測限以下的狀態。首先，研究團隊已成功地將 ICVAX 疫苗推進至 I 期臨床試驗，並展現了我們將科學發現逐步轉化至臨床試驗的過程及相關機制。此「香港製造」免疫治療候選藥物有望在未來用於愛滋病功能性治癒。其次，透過成立一個由傑出科學家和生物醫藥研發公司組成的香港聯盟，研究團隊成功生產了 GLP/GMP 級疫苗或抗體並進行了臨床前及臨床研究。團隊亦在多領域開發了 PD-1 增強型 DNA 疫苗。愛滋病領域以外，該疫苗也用於其他疾病領域，例如 COVID-19 和癌症，並取得兩項獲批的專利和一項受審批中的專利。第三，在此項 TRS 期間，我們在前沿科學期刊上發表了 20 篇科研論文，並在多個國際會議上發表了 17 份報告。另外，研究團隊受此項 TRS 啟發，亦成功獲批 4 項其他研究基金，這些科學研究亦將進一步加強研究團隊未來在傳染病領域的生物醫學基礎研究和藥物研發。

Control of Influenza: Individual and Population Immunity
流感控制：個人和群體免疫力

T11-712/19-N

Project Coordinator
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Participating Institutions
The Chinese University of Hong Kong
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Short Biography of Project Coordinator

Professor Ben Cowling is currently Chair Professor of Epidemiology, Head of the Division of Epidemiology and Biostatistics and Helen and Francis Zimmern Professorship in Population Health in the School of Public Health at the University of Hong Kong, and co-Director of the WHO Collaborating Centre for Infectious Disease Epidemiology and Control. He conducts research on the epidemiology and control of respiratory infections, particularly respiratory virus infections including COVID-19 and influenza. He's a Clarivate Web of Science "Highly Cited Researcher" since 2021 and among the "top 1% most cited scientists" since 2014.

項目統籌人簡介

高本恩現為香港大學公共衞生學院的流行病學講座教授、流行病和生物統計學分部主任及施玉榮伉儷基金教授席（民眾健康），同時擔任世界衞生組織傳染病流行病學及控制合作中心聯席總監。高教授從事有關呼吸道感染流行病學及控制的學術研究，特別是 2019 冠狀病毒病和流感等呼吸道病毒感染。2021年起他入選科睿唯安「最廣獲徵引研究人員」，2014 年起躋身「獲徵引次數位於前 1% 的科學家」。

Project Summary

Influenza causes more health impact than any other infectious disease in Hong Kong, each year, prior to the COVID-19 pandemic.

Influenza vaccines are the most used seasonal vaccines in the world (more than 500 million doses administered worldwide each year, more than 1 million in Hong Kong), but their effectiveness is not as good as we would like in some years.

This funded project has been studying human immunity to influenza with the aim of improving our scientific knowledge, enhancing efficiency of vaccines, and more generally reducing the health impact of influenza in Hong Kong each year.

We redirected efforts towards COVID-19 research in the first two years of the pandemic, making important contributions to evidence-based policies to reduce the impact of the pandemic.

項目概要

在 2019 冠狀病毒病（COVID-19）大流行之前，流感相對其他傳染病，每年對香港公眾的健康問題影響較大。

流感疫苗是世界上最常用的季節性疫苗（全球每年使用劑量超過 5 億劑，香港超過 100 萬劑），但有時候其抗病效果不似預期。

此資助項目研究人類對流感的免疫力，加強我們的科學知識，提升疫苗有效性，以減低流感每年對香港公眾健康問題的影響。

首兩年此項目重點轉為 2019 冠狀病毒病大流行研究，為減少大流行影響的實證政策作出了重要貢獻。

International Conference on Individual and Population Immunity to Respiratory Viruses, held on November 8-10, 2023
2023 年 11 月 8 至 10 日舉行了以「個人和群體對呼吸道病毒的免疫力」為題的國際性會議

Photo of Project Team and Scientific Advisory Board 研究團隊與科學諮詢委員會留影

Abstract

Influenza is a major threat to global public health. Seasonal influenza viruses cause annual epidemics with significant morbidity and mortality but existing vaccines are not optimal. Our own studies have shown that hemagglutination inhibition antibody titers, which are the current correlate of protection against influenza, only explain around 57% of the protective effect of conventional inactivated vaccines. These antibodies are even less correlated with the protection provided by live attenuated influenza vaccines or new vaccines currently in development.

Therefore, key knowledge gaps addressed in this project: (a) what are the immune correlates of protection against influenza infection or severe disease; (b) which of these are induced temporarily or permanently by prior natural infection or different types of vaccination; (c) what are the factors which contribute to increased susceptibility of populations to influenza epidemics; (d) how should we best deploy new and existing influenza vaccines to reduce the impact of influenza epidemics and pandemics; and (e) what are other immunological mechanisms relevant to the development and evaluation of new influenza vaccines. The relevance of these and other previously undefined mechanisms for protection against infection and disease in humans is the major knowledge gap.

Research Impact

Our research program has produced important and high-impact scientific findings on individual and population immunity to influenza, and made essential contributions to evidence-based policy making during the COVID-19 pandemic. Our multidisciplinary influenza research group is recognised as world-leading, and demonstrated our value to Hong Kong SAR, greater China, and the world during the COVID-19 pandemic where we published a large number of top-tier publications, advised local, national and international health agencies, and frequently communicated our knowledge and recommendations to the public via traditional and social media.

項目簡介

流行性感冒嚴重威脅全球公共衞生。季節性流感病毒能導致每年流感大流行及引發顯著的發病和死亡率，但現有的流感疫苗並非最佳的抗病疫苗。我們過往的研究發現，血球凝集抑制抗體滴度（目前已知具有防護流感感染的抗體滴度）僅能解釋常規滅活疫苗約 57%的保護作用。這些抗體較目前正在研發的減活或新型流感疫苗所提供的保護性更低。

因此，此項目關鍵的知識差距為：（一）什麼是預防感染或嚴重疾病的免疫相關保護因子；（二）哪些免疫相關保護因子屬暫時或永久性，並源自先前的自然感染或不同類型的疫苗接種；（三）什麼因素導致人類群體對於流感有更高的易感性；（四）如何有效地配給嶄新和現有的流感疫苗，以減輕流感大流行和流行病的影響；（五）了解免疫機制以開發和評估下一代新型流感疫苗。此研究項目有助了解上述領域和其他未釐定的人類病毒感染之後宿主的免疫機制。

研究影響

我們的研究計劃在個人和群體的流感免疫力方面取得了重要且具有很高影響力的科學成果，並在 2019 冠狀病毒病大流行期間為實證政策作出了重要貢獻。我們的跨學科流感研究團隊獲認可為全球領先，在 2019 冠狀病毒病大流行期間，我們發表了大量頂尖論文，為本地、國家和國際衞生機構提供意見，並通過傳統和社交媒體頻繁地向公眾傳播知識和提供建議，向香港特別行政區、大中華地區及世界展示了我們的價值。

Fighting Disease Recurrence and Promoting Tissue Repair after Liver Transplantation: Translating Basic Discoveries to Clinical Excellence

肝移植後原發病復發和組織修復的科研攻堅：從轉化基礎研究到優化臨床決策

T12-703/19-R

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Short Biography of Project Coordinator

Nancy Kwan Man, MBBS, MS, PhD, is the Chair Professor of Transplant Oncology and Immunology in Department of Surgery, The University of Hong Kong. She is the Director of Clinical and Translational Research Laboratory, Director of Liver Transplantation and Liver Cancer Research, and Director of the Laboratory for Organ Transplantation and Regeneration. She is also the President of Hong Kong Society for Immunology, and President of Hong Kong Scientist Association.

Dedicated to enhancing the outcomes of liver transplantation through reducing graft injury and cancer recurrence, Nancy leads research endeavours encompassing basic, clinical, and translational studies resulting in major advances on transplant oncology and immunology in the world. As the top 2% Scientists Worldwide on Stanford List, Nancy has published more than 210 papers in leading international journals with 17000 citations (H index 74). She and her team received numerous international awards including Basic Science Established Investigator Award and Rising Star Awards from International Liver Transplantation Society (ILTS), and Mentor/Mentee Awards from The Transplantation Society (TTS).

項目統籌人簡介

萬鈞教授現任香港大學外科學系講座教授（移植腫瘤學及免疫學），香港大學外科學系臨床與轉化實驗室主任，器官移植與再生實驗室主任，肝移植與肝癌實驗室主任。主要從事肝臟移植損傷，肝癌及其肝移植後腫瘤復發的臨床，轉化和基礎研究，提出移植腫瘤學與免疫學的新概念。發現並闡明小體積移植肝損傷及肝移植後肝癌復發的新機轉。研究成果處於相關領域的國際領先水平，並在多家國際知名期刊上發表了超過 210 篇論文，其中包括：Journal of Hepatology, Gastroenterology, Annals of Surgery, Transplantation, Liver Transplantation, Clinical Cancer Research and Cancer Research, New England Journal of Medicine, Nature Medicine 等。引用次數超過 17000 次 (H index 74)。2013-2019 年起連續七年被評為港大最高（1%）引用率學者，她是史丹福大學 2023 全球前 2% 頂尖科學家。近 16 年來萬鈞教授帶領的研究團隊在肝臟移植，肝癌和肝炎的研究領域獲得超過 65 項國際大獎。

Project Summary

To understand the role of regional specialization of immune system in tumor recurrence and hepatitis B after liver transplantation by the approach of systems biology integrated with a series of clinical, basic and translational studies. The new concept of immunotherapies will be developed by educating the intragraft immune micro-environment to prevent tumor recurrence after liver transplantation and to achieve the long-term survival.

To establish a new modeling system that integrates high-throughput sequencing data and biology/immunology parameters not only for predicting disease recurrence and prognoses, but also for therapeutic guidance.

To explore the mechanism of marginal liver graft injury and to establish novel therapeutics to overcome graft injury by using bioengineered cells targeted for regional tissue repair and functional regeneration.

項目概要

通過一系列基礎、臨床與轉化研究來揭示肝移植後原發病復發的機制，尋找有效的生物標記物，並開發新的免疫治療方案，從而減少移植後乙肝和肝癌的復發，提高肝移植病人的長期生存率。

整合高通量基因測序及生化和免疫數據，建立一個嶄新的智能模型，不僅能用於腫瘤復發的預測，亦對治療策略的選擇具有重要的指導意義。

探索促進肝組織修復和再生的新策略，為進一步擴大供體來源和避免移植肝損傷及失功能提供理論依據和新的治療方案。

Project Coordinator and her team 項目統籌人及團隊

Abstract

During the past two decades, we have successfully built an internationally renowned liver transplantation centre in Hong Kong. We pioneered in living donor liver transplantation (LDLT) using the right lobe liver graft in the world. This surgical innovation has successfully rescued almost 1500 patients with end-stage liver diseases and liver cancer in this sole transplantation center of Hong Kong. However, the prevalence of hepatitis B virus (HBV) infection, high incidence of liver cancer (Hepatocellular carcinoma-HCC) and the shortage of deceased organ donors in Hong Kong has burdened heavily on the healthcare systems. We face the grand challenges of recurrent diseases and liver graft injury after transplantation. Our TRS aims to improve the long-term outcomes of liver transplantation by tackling two major recurring diseases including cancer recurrence and HBV reactivation in Hong Kong through exploring underlying mechanisms, identifying efficacious biomarkers, and developing potential treatments by integrating basic, translational and clinical research. We hypothesize that novel approaches promoting liver tissue repair and regeneration will abrogate the limit of donor organ shortage. We have established a Biobank with comprehensive clinical database for more than 20 years with around 50000 tissue and liquid biopsies from almost 1400 adult recipients with 100% of patient follow-up. Based on this Biobank, we will establish a modeling system that integrates high-throughput sequencing data and biology/immunology parameters not only for predicting disease recurrence and prognoses, but also for therapeutic guidance. We will develop cost-effective immunotherapies as novel prophylaxis, especially for the pre-treatment of living donors, to benefit the recipients' long-term outcomes with both societal and economic impact. The proposed multidisciplinary collaborative project will not only strengthen our local and regional excellence, but also enhance Hong Kong as an internationally leading centre of excellence in liver transplant. In addition to patient and economic benefits, this project will cement Hong Kong's international stature in science, medicine and education.

Research Impact

We will address the key issues of disease recurrence after liver transplantation through exploring the underlying mechanisms, identifying efficacious biomarkers, and developing new concept targeting immunotherapies as well as precise stem cell treatments through the integration of basic, translational and clinical research. The proposed study will not only generate scientific publications and patents, but also provide many opportunities to train future research talents. In addition to bibliometric output and education, we will also develop a unique computer modeling system essential for both disease prognoses and therapeutic guidance. Such novel digitalized platform and database will be durably important to form the infrastructure for precision medicine in transplantation. Discovery of druggable targets and exploration of new therapeutic strategies targeting disease recurrence after transplantation will open a new window for collaboration with local industries to enhance technology transfer. Development of novel immunotherapy will benefit the recipients' long-term outcomes with both societal and economic impact.

項目簡介

在過去的二十多年，我們成功建立了蜚聲國際的香港大學瑪麗醫院肝臟移植中心，在全球率先開展了成人右半肝活體肝移植。這項外科技術的創新挽救了香港地區近一千五百位患有終末期肝病和肝癌的病人。目前，香港地區乙型病毒性肝炎和肝癌的高發病率給本地醫療保健系統帶來沉重的負擔，肝移植後發生的移植肝損傷和原發病包括乙肝和肝癌的復發也是我們面臨的巨大挑戰，這更使香港醫療保健系統百上加斤。我們的研究專案旨在通過一系列基礎、臨床與轉化研究來揭示肝移植後原發病復發的機制，尋找有效的生物標誌物，並開發新的治療方案，以減少移植後乙肝和肝癌的復發，提高肝移植病人的長期生存率。為解決腦死亡供體匱乏的問題，我們也致力於探索促進邊緣性供肝組織修復和再生的新策略。我們的肝移植中心已建立了逾二十年的生物樣本庫與病人資料庫，其中包括近一千四百位肝移植病人的組織和血樣本五萬多個，病人的隨訪率達到百分之百。基於這個完善的生物樣本庫與病人資料庫，我們將整合高通量基因測序及生化和免疫資料，建立一個嶄新的智能模型，不僅能用於腫瘤復發的預測，而且對治療策略的選擇也有重要的指導意義。我們也將開發新型免疫治療以改善病人預後，在擴大病人獲益的同時創造更好的社會與經濟效益。此項多學科合作研究不僅能鞏固我們肝臟移植中心在亞太地區的領導地位，而且可以進一步強化我們在國際移植界，特別是活體肝移植領域的領先優勢，亦更有利於提升香港在科學、醫療和教育的國際地位。

研究影響

我們研究團隊針對肝移植後原發病復發的臨床問題和科學問題，將進行一系列綜合性的基礎、轉化和臨床研究，冀在乙肝復發的新型免疫治療、移植肝損傷研究的新理論、腫瘤復發機理的全新闡釋和原發病復發的治療新策略等方面取得突破性進展和新發現，這對於指導臨床決策和夯實肝移植後原發病復發的理論基礎具有奠定性的重要作用。系列研究也將闡明肝移植術後原發病復發的關鍵機制及調控途徑，不僅能豐富移植免疫與腫瘤免疫新理論，亦為個體化預防原發病復發和改進免疫調控方案提供理論依據和技術支撐，為香港地區乃至全國和全球的乙肝與肝癌防治提供最優化解決方案。研究團隊也將和本地醫藥企業進行協作研發，為進一步開展臨床試驗打下良好的基礎，開發更具成本效益的新型免疫治療將創造更好的社會與經濟效益。

Sustainable Marine Infrastructure Enabled by the Innovative Use of Seawater Sea-Sand Concrete and Fibre-Reinforced Polymer Composites

基於海水海砂混凝土與纖維增強複合材料的新型可持續海洋工程結構

T22-502/18-R

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Participating Institutions
City University of Hong Kong
The Hong Kong University of Science and Technology
Southern University of Science and Technology
University of Macau
Vanderbilt University
University of London

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Short Biography of Project Coordinator

Professor Tao YU is a Professor in Structural Engineering in the Department of Civil and Environmental Engineering and an Associate Director of the Research Institute for Sustainable Urban Development at The Hong Kong Polytechnic University. Professor YU's research focuses on infrastructure applications of composite materials, with emphasis on innovative hybrid structures enabled by fibre-reinforced polymer (FRP) and FRP-seawater sea-sand concrete (SSC) structures. Professor YU has authored or co-authored over 160 research papers, which have received over 9000 citations. Professor YU is one of the main contributors for the Chinese national standard "Technical Standard for FRP in Construction (GB50608-2020)" and an inventor of several novel high-performance structural elements incorporating FRP. Professor YU received many prestigious awards, including the Distinguished Young Researcher Award from the International Institute for FRP in Construction (IIFC), and the 2018 Golden Wattle Award (Top Ten Outstanding Australian Chinese Youth).

項目統籌人簡介

余濤教授現任香港理工大學土木及環境工程學系結構工程教授及可持續城市發展研究院副院長，主要研究領域為土木工程複合材料結構，包括新型複材組合結構及複材 - 海水海砂混凝土結構，發表學術論文 160 餘篇，論文被引 9000 餘次。余濤教授是國家標準《纖維增強複合材料建設工程應用技術規範 - GB50608》的主要起草人之一，也發明了多種新型高性能複材組合構件，曾獲國際土木工程複合材料學會傑出青年學者獎、澳大利亞十大傑出華人青年金合歡獎等獎項。

Project Summary

The fundamental mechanisms of seawater sea-sand concrete (SSC) have been clarified, and various types of SSC have been developed through mix proportion optimisation.

Various innovative forms of FRP-SSC structural members and connections have been developed, and reliable design methods have been established for them.

Various types of sensors, including pH, moisture, chloride, sulphate sensors, have been developed and integrated into a sensing system for hybrid monitoring of the long-term performance of FRP-SSC structures.

A performance simulation platform based on multi-scale multi-physics modelling of deterioration at the material and structure levels and the accelerated and field exposure tests has been established for predicting the long-term performance of FRP-SSC structures.

項目概要

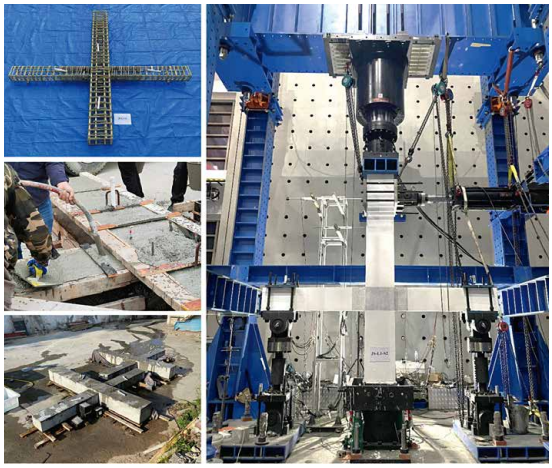
闡明海水海砂混凝土（SSC）的基本機理，並在此基礎上通過配合比優化研發多種類型的 SSC。

研發多種新型 FRP-SSC 結構構件和連接，並為其建立可靠的設計方法。

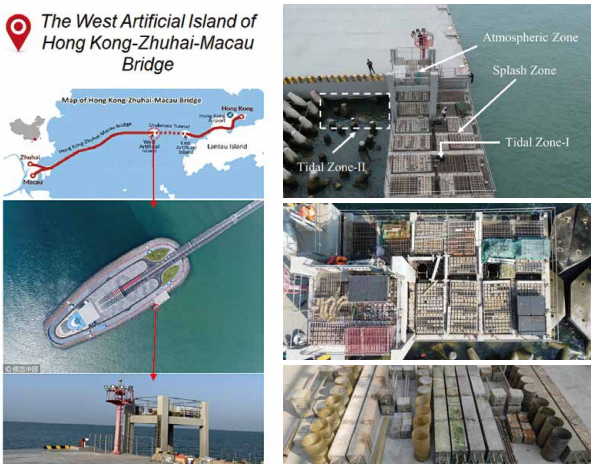
研發多種類型的傳感器，包括 pH、濕度、氯離子和硫酸根離子傳感器，並將其集成到傳感系統中，用於混合監測 FRP-SSC 結構的長期性能。

基於材料和結構層面劣化的多尺度、多物理場模擬以及加速和現場暴露試驗的結果，建立一個性能模擬平臺，用於預測 FRP-SSC 結構的長期性能。

The 7th FRP-SSC Workshop 第七屆FRP-SSC國際研討會



Test on FRP-SSC Beam-Column Connection
FRP-SSC梁柱節點試驗



Exposure Tests at the West Artificial Island of
Hong Kong-Zhuhai-Macau Bridge 港珠澳大橋西人工島海洋暴露試驗

Abstract

Coastal cities like Hong Kong rely heavily on their coastal and marine (referred to as "marine" hereafter for brevity) infrastructure for social-economic development. There are two major challenges for marine infrastructure. One is steel corrosion, which is the main cause for infrastructure deterioration. Another is the shortage of fresh water and river sand for making concrete. This project aims to address both challenges by developing a new type of concrete structures to achieve sustainable marine infrastructure: seawater sea-sand concrete (SSC) structures reinforced with fibre-reinforced polymer (FRP) composites (referred to as FRP-SSC structures). As FRP composites have excellent corrosion resistance, they are gaining increasing acceptance as replacement of steel in conventional reinforced concrete structures in aggressive environments. By capitalising on the durability of FRP composites, seawater and sea-sand can be directly used in constructing marine infrastructure. The project team has developed mix proportions for SSC of different grades, various innovative forms of FRP-SSC structural members and connections, as well as various sensing technologies for long-term monitoring of FRP-SSC structures. Furthermore, the project team has developed a performance simulation platform for the long-term performance of FRP-SSC structures.

Research Impact

As demonstration projects, the project team has succeeded in constructing FRP-SSC paving slabs for the road of a sewage treatment plant in Hong Kong as well as an FRP-reinforced seawater concrete structure in mainland China. FRP-SSC structures are also being used in two other demonstration projects in Hong Kong, for the reconstruction of a pier and for the construction of a wave wall, respectively. With continuous efforts of the project team and the relevant government departments and industry partners, wider applications of the new type of structures in Hong Kong and beyond can be expected.

The research outcomes of this project constitute a major technological breakthrough in marine infrastructure which is of great importance to Hong Kong as a coastal city. With their many advantages, FRP-SSC structures will revolutionise the construction of marine infrastructure. The research outcomes of this project will also provide a strong basis for Hong Kong to export the related technologies in sustainable marine infrastructure to mainland China and beyond.

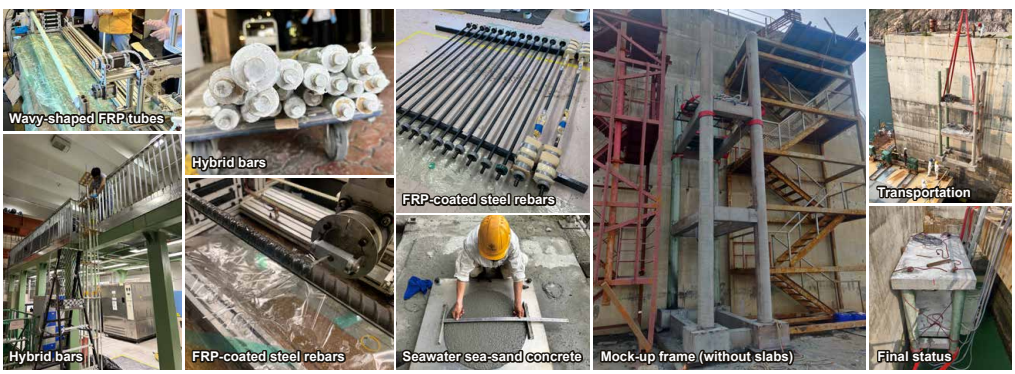
項目簡介

香港和其他沿海城市的社會經濟發展高度依賴其海岸及海洋基礎設施（統稱為海洋基礎設施）。海洋基礎設施面臨的主要挑戰有兩個。一是鋼材銹蝕，這亦是工程結構劣化的主要原因。另一個是混凝土原材料淡水及河砂資源的短缺。為解決上述兩項挑戰，本項目旨在研發一種新型混凝土結構以實現可持續海洋基礎設施的目標。該種新型混凝土結構是由纖維增強樹脂基複合材料（FRP）與海水海砂混凝土（SSC）組合而成的複合材料 - 海水海砂混凝土結構（簡稱為 FRP-SSC 結構）。由於 FRP 優越的耐腐蝕性，採用 FRP 替代侵蝕環境下傳統鋼筋混凝土結構中的鋼材，在實際工程中得到了日漸廣泛的應用。一旦採用了 FRP 作為增強材料，海水、海砂將可直接用於建造海洋工程混凝土結構。項目團隊研發了不同等級 SSC 的配合比、各種創新形式的 FRP-SSC 結構構件和連接，以及用於 FRP-SSC 結構長期健康監測的各種傳感技術。此外，項目團隊還為 FRP-SSC 結構的長期服役開發了一個性能模擬平臺。

研究影響

作為示範項目，項目團隊已成功建造了用於香港污水處理廠道路的 FRP-SSC 路面板，以及位於中國大陸的一個 FRP-SSC 結構。FRP-SSC 結構也正在被用於香港的另外兩個示範項目，包括一個碼頭重建項目和一個擋浪牆項目。在項目團隊和相關政府部門及業界夥伴的不斷努力下，這種新型結構有望在香港和其他地區得到更廣泛的應用。

本項目的研究成果是海洋基礎設施領域的重大技術突破，對香港這個沿海城市具有重要的意義。FRP-SSC 結構具有很多優點，將徹底改變海洋基礎設施的建造方式。這個項目的研究成果，亦會為香港向中國內地和其他地區輸出可持續海洋基建相關技術，奠定穩固的基礎。



Full-Scale FRP-SSC Frame Constructed at Guishan Island, Zhuhai
建於珠海桂山島的足尺寸FRP-SSC框架

A Paradigm-shifting, Fully-integrated, Compact Wastewater-to-resource Facility (WWRF)

未來污水淨化與資源回收一體化工場(未來水工場)

T21-604/19-R

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The Chinese University of Hong Kong
City University of Hong Kong
The University of Hong Kong
Delft University of Technology
University of Cape Town
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開普敦大學
根特大學

Short Biography of Project Coordinator

Professor Guanghao CHEN is a Chair Professor in the Department of Civil and Environmental Engineering and the Division of Environment and Sustainability at the HKUST. He is the founding director of the Hong Kong Branch of the Chinese National Engineering Research Center for Control and Treatment of Heavy Metal Pollution. He serves as the Director of Water Technology Center and Associate Director of the Institute for the Environment at HKUST. Professor CHEN is a mentor at the Global Sanitation Graduate School and a member of the Strategic Council of the International Water Association (IWA). He is also an editor of Water Research. Recognized as an IWA Distinguished Fellow in 2016, Professor CHEN has produced pioneering work including the well-known SANI® process for sludge-minimized biological wastewater treatment, and other new technologies such as SOSA®, LEEO®, and ECO® for sludge reduction, sludge odor control, and landfill leachate treatment. He has won more than 10 domestic and international awards and obtained over 20 invention patents in the Mainland and the United States.

項目統籌人簡介

陳光浩教授現任香港科技大學土木及環境工程學系、環境及可持續發展學部講座教授，國家重金屬污染防治工程技術研究中心香港分中心主任，香港科技大學水技術中心主任，環境研究所副院長，全球衛生研究生院指導專家，國際水協會 (IWA) 戰略局委員，國際水領域著名學術期刊《Water Research》編輯，並在 2016 年獲選國際水協會傑出會士。陳教授主要從事原創科研工作包括沿海城市污水污泥處理創新技術研發和應用 (如 SANI® 工藝，SOSA® 工藝，LEEO® 技術)，高濃度垃圾滲濾液處理與示範 (ECO® 技術) 和城市污水處理能耗最小化與資源回收最大化的未來處理系統及相關技術的研發。先後獲得國內國 際獎項共 10 多項和 20 多項中國內地及美國發明專利。

Project Summary

Develop an energy-efficient, compact, and waste-minimized wastewater treatment process

Increase water resources cost-effectively while minimizing energy/chemical usage

Help produce/recover value-added biochemicals

Reduce the carbon footprint and environmental impacts of wastewater treatment plants

項目概要

研發節能、佔地少、減排的污水處理工藝

增加水資源同時減少成本、能耗和化學品的使用

實現高附加值生物化學材料的生產和回收

減少污水處理與回用過程的碳足跡和環境影響

Pilot-scale testing of a novel wastewater technology—SANIA
SANIA 創新工藝技術的中試研究

Pilot-scale hybrid forward osmosis and reverse osmosis system for high-quality water production from wastewater
用於高品質水回用的正滲透-反滲透集成系統的中式示範

Abstract

Water scarcity is threatening the sustainable growth of cities worldwide, including Hong Kong, which imports approximately 70% of its freshwater from mainland China. The city has also adopted a dual-pipe system that supplies potable water for commercial and domestic purposes, while providing seawater for toilet flushing, saving 22% of its freshwater resources. Although effective in combating water scarcity, this dual-pipe system is expensive to maintain, and water importation costs are rising annually by 6%. A conventional solution to urban water scarcity is to reuse wastewater. However, three major issues persist. First, current reuse practices often involve costly and space-/energy-intensive post-treatments. Second, many wastewater technologies in use today are inefficient in terms of space utilization, energy consumption, and resource recovery. Third, most of these technologies produce substantial amounts of solid waste and brine wastewater, which are difficult to treat. To address these challenges, leading experts in water science and technology have collaborated with top researchers and engineers to develop a revolutionary wastewater treatment and reuse system known as the **W**aste**W**ater-to-**R**esource **F**acility (**WWRF**). The fully-integrated, compact facility leverages novel membrane, chemical, and biological technologies to efficiently produce potable water and valuable biochemicals from saline wastewater, minimizing waste disposal.

Research Impact

This project team has developed a paradigm-shifting wastewater system for treating and reusing saline wastewater. A pilot-scale plant has been built at a local sewage treatment facility to test, optimize, and showcase the novel technologies and system. The trial is scheduled for completion by 2025. Embracing a comprehensive approach to water management, the new system integrates fresh, grey, saline, and brine water resources under the principle of “water is water, resource is resource.” In the short term, the project outcomes could facilitate the retrofitting of existing water treatment plants or the implementation of new systems, providing an alternative source of potable water and fostering sustainable urban development. In the medium term, the project aims to mitigate freshwater scarcity challenges in island and coastal areas, as well as supporting the development of floating cities to adapt to rising sea levels caused by global warming. Our research team has published over 170 peer-reviewed papers in reputable journals, including 59 papers in Nature Index journals. Our textbook, “Biological Wastewater Treatment, 2nd edition,” with Professor Guanghao CHEN serving as the lead editor, was awarded the Best Scientific Book prize from the International Water Association (IWA), the world’s largest water professional network. Two technologies developed in this project, the “Economic Energy-Efficient Membrane Bioreactor” (3E-MBR) and the “Low Energy Electrical Odor control of sludge” (LEEO®) technology, received the Silver Medal at the 48th International Exhibition of Inventions Geneva. The pilot study for LEEO® at Siu Ho Wan Sewage Treatment Works was honored as the Champion for the Mechanical Innovation and Implementation Award by the Institution of Mechanical Engineers (HK Branch). LEEO® also received the first round of RAISe+ funding from the HKSAR Government. Furthermore, this project has nurtured over 80 postgraduates, postdocs, and research personnel.

2023 National & International Water Summits for Key Green Water Tech Research and Development (June 4–9, 2023)
2023國內國際水雙高峰大會未來綠色水科技研究與應用（2023年六月四至九日）

項目簡介

水資源短缺正威脅全球城市的可持續發展。目前香港從中國大陸進口約 70% 的淡水並採用雙管道供水方式–即一條管道提供海水作為沖廁用途（可節約 22% 的淡水需求）而另一條為市民提供食水作其他商業和居民用途的方法，有效暫緩了水短缺的嚴重問題。儘管此系統效果顯著，雙管系統成本依舊很高，而且東江水的水價每年會增漲 6%，這些都可能影響著香港的可持續發展。解決城市水資源短缺問題的不二方法是盡可能實現污水規模化回用。然而實際應用的過程中依然存在三大主要瓶頸問題：1）目前的回用技術通常涉及高成本和高佔地 / 能量密集的後期處理；2）當前使用的許多污水處理技術在空間利用、能源消耗和資源回收方面效率較低；3）現有污水回用技術產生大量難以處置的污泥殘渣和高鹽廢水造成二次污染。為應對這些挑戰，領先的水科學技術專家與頂尖研究員和工程師合作，開發了一種革命性的廢水處理和再利用系統（WWRF）。由此產生的全面協同，緊湊節能的廢水資源化設施將採用創新新穎的膜技術、化學和生物技術，高效生產可飲用水和來自鹽水廢水的高附加值生化物質，同時最大限度地減少廢物處置。

研究影響

項目團隊開發了一套創新的污水系統，用於處理和再利用含鹽廢水。目前，我們正在一個本地污水處理廠 進行中試，以測試、優化和展示提出的新技術和系統，並計劃於 2025 年完成。該項目展示了我們綜合水資源管理的方法，涵蓋了淡水、灰水、鹽水和濃鹽水等各種類型的水資源，通過「水即水，資源即資源」的原則。短期內，該項目的成果有望促進傳統水處理廠的改造或新水系統的實施，提供替代的飲用水源，為可持續城市發展做出貢獻。中期內，該項目旨在應對島嶼和沿海地區的淡水短缺問題，並發展未來的海上浮動城市，以應對全球變暖導致的海平面上升問題。研究團隊已在知名期刊上發表了 170 多篇同行評議的論文，其中包括在自然指數期刊上發表 59 篇論文。此外，由陳光浩教授擔任主編的教科書《生物廢水處理第二版》榮獲國際水協會（全球最大的水業專業組織）頒發的首個最佳科學書籍獎。此外，該項目開發的兩項技術，即「經濟節能高效膜反應器 3E-MBR」和「低電能污泥除臭氣技術 LEEO®」，均獲得了第 48 屆日內瓦國際發明展的銀獎。LEEO® 在小壕灣污水處理廠試點研究中獲得了由機械工程師學會（香港分會）頒發的「機械創新與實施獎」的冠軍 稱號。LEEO® 也獲得了特區政府首屆「產學研 1+ 計劃」(RAISe +) 的資助。此外該項目共培養了 80 多名研究生、博士後和研究人員。

SureFire: Smart Urban Resilience and Firefighting

SureFire：智慧城市災害防控和火災應急研究

T22-505/19-N

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Tsinghua University
University of Edinburgh

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Short Biography of Project Coordinator

Professor Asif USMANI is Chair Professor and head of Department of Building Environment and Energy Engineering (BEEE). Professor USMANI is Project Coordinator (PC) for SureFire. His research focuses on understanding the thermo-mechanical behaviour of civil infrastructure in real fires using analytical and computational approaches validated with experimental data. The aim is to enable current practice to move on from prescriptive design of structural fire resistance by developing new and rational design methods in which realistic representations of demand (fire hazard) are set against scientifically robust estimates of structural capacity in order to ensure reliable performance. His research output includes over 200 peer-reviewed publications, authored and edited books, and many technical reports. He has obtained research grants in excess of HK$100 million, including the Research Grants Council (RGC) funding for SureFire.

項目統籌人簡介

Asif USMANI 教授是建築環境與能源工程系（BEEE）的講座教授和系主任。USMANI 教授是 SureFire 的項目統籌人。他的研究重點是通過分析和計算方法來理解民用基礎設施在真實火災中的熱力學行為，並用實驗數據進行驗證。目的是通過開發新的合理的設計方法，使現行的結構防火設計實踐不完全依賴規範進行設計。在這些新的方法中，科學可靠的結構承載能力計算與火災危險條件下的實際需要相對應，以確保可靠的性能。他的研究成果包括 200 多篇同行評審的論文、專著與參與編輯的著作、和許多的研究報告。他所獲得的研究資金超過 1 億港元，包括研究資助局為 SureFire 項目提供的資金。

Project Summary

The key thrust of research effort in this project is to build all the components of the **SureFire** system so that it has forecasting capability. The roles of the key components of the system are as follows:

- **Digital twin:**
  Use the Building Information Model (BIM) to create a digital twin of targeted buildings incorporating the sensor network and create an Internet-of-Things (IoT) based framework for regular updating of the digital twin. Develop efficient methods to construct geometric model of an existing building where a BIM model is unavailable.

- **Communication networks for data collection:**
  Real time data from the emergency location is collected from sensors and relayed to the emergency response command and control (C&C).

- **Data analysis, incident simulation and forecasting:**
  The concept of Event Library Forecasting (ELF) is developed and adopted. The ELF database with big data analytics and AI/machine learning techniques train the AI model and enable SureFire for practical implementation. Sensor steered "simulation tools" based on pre-trained AI models forecast the evolution of the fire, establish its impact on the structure and analyse intervention alternatives and evacuation strategies. All of this happens faster than the evolution of the emergency in real time.

- **Feedback to incident venue:**
  Updated forecasts are relayed continuously to actuators, C&C and incident commander (IC) in forms easily assimilated by the recipients for aiding decisions.

- **Smart emergency response:**
  Effective coordination between C&C, IC and firefighters using unambiguous execution support helps them implement effective response without delay.

SureFire focuses mainly on the 2nd and 3rd components (Networking and Forecasting) as they represent the most fundamental research challenges in achieving the desired capability.

項目概要

該項目研究工作的主要推動力是構建 SureFire 系統的預測能力。關鍵內容如下：

- **數字孿生：**
  使用建築資訊模型（BIM）創建目標建築物的數字孿生模型，包括傳感器網路，並創建基於物聯網（IoT）的框架，用於定期更新數字孿生模型。開發有效的方法來構建沒有BIM模型的現有建築的幾何模型。

- **數據收集的通信網路：**
  從傳感器收集緊急事故現場的實時數據，並傳送到應急響應指揮與控制（C&C）中心。

- **數據分析、緊急事件模擬和預測：**
  開發並採用了事件庫預測（ELF）概念。結合大數據分析和人工智能（AI）/機器學習技術，用ELF數據庫訓練AI模型，使SureFire能夠進行實際應用。由傳感器數據引導的帶有AI模型的"模擬工具"可以預測火災的演變，確定其對結構的影響，並分析救援的可選方案和疏散策略。所有這些分析和預測比實時發生的緊急事件的變化還要快。

- **緊急事件現場反饋：**
  更新的預測結果不間斷地傳送給執行者、指揮與控制中心和現場指揮官（IC），反饋的形式便於理解，幫助他們做出決策。

- **智能應急響應：**
  C&C、IC 和消防員之間有效的協調，使用明確的指令協助他們及時地實施有效回應。

SureFire 主要集中研究第二和第三項（網路和預測），這兩項是最為基礎的研究，充滿挑戰。

Fire test with HK FSD (2021)
與香港消防局進行火災實驗（2021）

Demonstrate firefighting robot to children at Geneva (2024)
在日內瓦展示消防救火機器人（2024）

Abstract

SureFire integrates smart building technology, state-of-the-art fire simulation, event library forecasting database (big-data) to develop an Artificial Intelligence (AI) based tool providing timely forecasts of critical events to assist firefighters in making informed decisions. A high-level framework divides the project into three work packages. Through Digital Twin, SureFire coordinates BIM and IoT technologies to dynamically project the physical world into the digital world. The system continuously monitors a building or other infrastructure facility, and the event of a fire engages the AI subsystem to begin generating forecasts and relays decision support information to fire crews and alerting them to probable critical events and the time and place they may occur.

項目簡介

SureFire 集成了智慧建築技術、最先進的火災模型、事件預測資料庫（大數據）以及開發基於人工智慧（AI）的應用工具，及時預測危險事件，以協助消防員做出明智的決策。根據研究內容該項目分為三個課題。通過數位孿生技術，SureFire 協調建築資訊模型（BIM）和物聯網（IoT）技術，將物理世界動態地投射到數位世界中。該系統持續監控建築或其他基礎設施的內部情況，在發生火災時啟動 AI 子系統開始預測，並向消防隊傳遞支援資訊，預警可能發生的危險事件以及可能發生的時間和位置。

Research Impact

The primary goal of the project is to develop tools for data-assisted critical event forecasting in a fire emergency. The tools can be used to support emergency response in real time. SureFire has the potential to revolutionise the practices of urban fire services to the benefit of the general public, improve the efficiency and effectiveness of firefighting, enhance the safety of fire fighters, and improve the day-to-day fire safety management of buildings and urban infrastructure. Faculty of Construction and Environment, PolyU made an Impact Case Study video to showcase the SureFire project. It is one of the seven most impactful Sustainable Urban Development and Smart City researches.

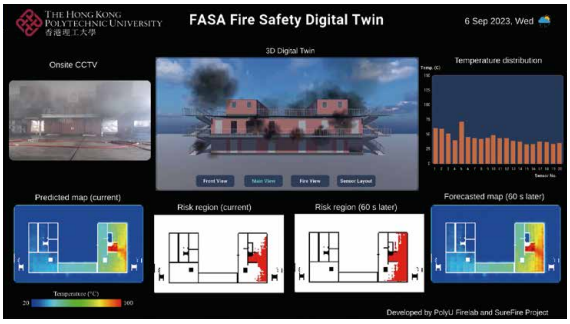
The project team is collaborating with a local start-up company, RaSpect Intelligence Inspection Limited, to apply for the Innovation and Technology Fund (ITF) project together and commercialize the device and systems proposed in the project. The project has led to two start-up companies, one focuses on the smart dynamic exit signage system powered by SureFire forecast engine, and the other focuses on the autonomous robotic firefighting driven by SureFire system. The research has resulted in 7 patents to date.

研究影響

本項目的主要目標是開發在火災緊急情況下用數據支撐預報危險事件發生的工具，並用於實時應急響應。SureFire 將可能極大地改變城市的公共消防安全服務、提高滅火效率、加強消防員的生命安全保障，並改善建築與城市基礎設施的日常火災安全管理。理工大學建設及環境學院為 SureFire 項目製作了案例研究視頻。這是可持續城市發展和智慧城市七個最具影響力的項目之一。

項目團隊正在與一家本地初創公司 RaSpect Intelligence Inspection Limited 合作，共同申請創新科技基金（ITF）項目，並將項目中提出的設備和系統商業化。該項目已經促成了兩家初創公司的成立，一家專注於由 SureFire 預測模型驅動的智慧動態出口指示系統，另一家專注於由 SureFire 系統驅動的自主機器人滅火。到目前為止，這項研究已經獲得了 7 項專利。

SureFire Workshop at Tsinghua (2023)
在清華大學舉辦 SureFire 工作坊（2023）



SureFire system Demo for fireman training facility
SureFire 系統演示消防訓練設施

Contributing to the Development of Hong Kong into a Global Fintech Hub
促進香港成為全球的金融科技樞紐

T31-604/18-N

Project Coordinator
Professor Kar Yan TAM
The Hong Kong University of Science and Technology

Participating Institutions
City University of Hong Kong
The Chinese University of Hong Kong
The University of Hong Kong
The Education University of Hong Kong

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Short Biography of Project Coordinator

Professor Kar Yan TAM is Chair Professor of Information Systems, Business Statistics and Operations Management at The HKUST. He is a researcher in Fintech and the diffusion of innovations in organizations, and serves on the editorial boards of several academic journals. Besides, he is a Board Member of the European Foundation for Management Development, and was the Past President of the Association of Asia Pacific Business Schools. He is also actively involved in public services, being the Chairman of the Hong Kong Committee for Pacific Economic Cooperation of the Hong Kong Government and a member of the Hong Kong Exchange Fund Advisory Committee of the Hong Kong Monetary Authority.

項目統籌人簡介

譚嘉因教授是香港科技大學資訊、商業統計及營運管理學系講座教授。他致力於金融科技和創新滲入機構的研究，並擔任多份學術期刊的編輯委員會成員。此外，他是歐洲管理發展基金會的董事會成員，曾任亞太商學院協 會主席。他還積極參與多項社會公職。他目前為太平洋經濟合作香港委員會主席，香港金融管理局外匯基金諮詢委員會成員。

Project Summary

Explored the economic implications of blockchain technology by analyzing validators' behaviors and the impact of transaction fees and economic incentives in permissioned blockchains, providing insights into potential improvements for blockchain-based payment systems in fintech.

Conducted an evaluation of the effectiveness of cybersecurity protection schemes for financial institutions, including the implementation status of C-RAF measures, and published a report to raise awareness about cybersecurity gaps.

Conducted robo-advising risk profiling through content analysis and developed a statistical model to understand potential clients' traits and attitudes in the Hong Kong financial market.

Collaborated with a bank in Hong Kong to analyze investment behaviors of robo-advising adopters and non-adopters; and developed a robo-advising system based on a novel risk estimation model that recommends Hong Kong stock portfolios based on risk preferences.

Created FinBERT, a deep learning-based language model for financial text analysis, and FinSent, a financial sentiment analysis application. Both applications are free for public use.

Developed a real-time systemic risk monitoring system using Advanced High-Frequency and High-Dimensional Analytics Techniques, and quantified market risk through statistical modelling.

Conducted a large-scale survey on the adoption of virtual banks and insurers and studied seven global fintech hubs to bridge gaps between fintech development and regulatory frameworks.

Conducted industry-wide studies on fintech talent development, focusing on core competencies, talent supply projections, and strategies to address talent shortages.

項目概要

透過分析驗證者的行為，以及交易費用和經濟誘因對許可區塊鏈的影響，我們探索了區塊鏈技術可帶來的經濟意義，以幫助理解如何改進區塊鏈技術支援的支付系統。

對金融機構的網絡安全保護方案進行了評估，包括實施網絡防衛評估框架 (C-RAF) 措施的狀況，並發布了一份研究報告以提高業界對網絡安全漏洞的認識。

透過內容分析法進行智能投資顧問風險評估，並開發了一個統計模型以助了解香港金融市場中潛在客戶的特徵和態度。

與香港一家銀行合作，分析智能投資顧問使用者和非使用者的投資行為；並根據一個新的風險評估模型開發了一個智能投資顧問系統，該系統可根據投資者的風險偏好推薦香港股票的投資組合。

開發了用於分析金融文本的深度學習語言模型 FinBERT，以及用於分析金融市場情緒的應用程式 FinSent。這兩個應用程式均免費開放予大眾使用。

利用先進的高頻和高維度分析技術開發了一個實時系統性風險監測系統，並通過統計建模量化市場風險。

針對虛擬銀行和保險業的應用情況進行了一項大型調查；並透過深入研究全球七個主要的金融科技樞紐，彌合金融科技發展及監管框架之間的差距。

針對金融科技人才發展進行了多項行業性研究，重點關注金融科技專業人士所需的核心能力、人才供應預測以及應對嚴重人才短缺的策略。

The project team released findings from the survey on *Public Attitudes Towards Virtual Assets* at a press conference on 17 October 2023 – Prof. Allen HUANG (Co-PI) and Ms. Christy YEUNG of the HKUST Fintech and Green Finance Projects
項目小組於2023年10月17日透過新聞發布會公布有關虛擬資產投資取態的公眾意見調查結果 – 黃昊教授 (聯合首席研究員) 和楊淑敏女士 (科大金融科技及綠色金融計劃主任)

HKUST Business School and HSBC collaborated on the "Hypothetical e-HKD" pilot program to explore and experiment on the application of CBDC in Hong Kong, under the guidance of the Hong Kong Monetary Authority (HKMA)
科大商學院與滙豐合作展開「假設性數碼港元」測試，在香港金融管理局的帶領下，共同探索和試驗在香港應用央行數碼貨幣

Abstract

The project aimed to build the intellectual foundation of a grand strategy on fintech for Hong Kong. In light of the impact of fintech on individual investors, financial institutions, regulators, and the finance industry as a whole, the project addressed the fundamental issues that sit at the intersection between technology and financial services, such as digital payment, financial product design and distribution, public disclosures and distributed ledger applications. A range of topics were addressed, including blockchain, cybersecurity, personalized risk assessment, robo-advising, applications of AI/machine learning in multimodal analysis of financial disclosures, modelling systemic risk using advanced quantitative techniques, analyzing fintech services to address policy questions, and fintech manpower development. The project generated significant research findings, as well as practical applications and policy recommendations that are instrumental in enhancing fintech development for Hong Kong, particularly in terms of regulatory environment, innovation pipeline, cooperation between incumbents and startups, and the recruitment and nurturing of fintech talent.

項目簡介

本項目的目標是為香港金融科技的宏觀策略建立學術基礎。鑑於金融科技對個別投資者、金融機構、監管機構以及整個金融業的影響，我們探討了一系列由科技及金融服務交匯衍生的主要議題，包括數碼支付、金融產品的設計及分發、公開披露和分布式分類帳應用等。本項目亦涵蓋多個研究主題，包括區塊鏈；網絡安全；個人化風險評估；智能理財；人工智能 / 機器學習在金融披露的多模式分析中的應用；使用先進量化技術模擬系統風險；分析如何使用金融科技服務解決政策問題與促進金融科技人才發展。本項目所產生的研究成果、實際應用和政策建議對促進香港金融科技發展具重大意義，特別是在監管環境、創新渠道、現有企業與初創公司之間的合作，以及金融科技人才的招聘和培訓方面。

Research Impact

Our research has significantly enhanced Hong Kong's fintech capabilities on multiple fronts:

- **Industrial Impacts:**
  We developed a number of practical applications using emerging technologies, such as FinBERT and FinSent, which have been widely recognised. We also collaborated with the Joint Financial Intelligence Unit (JFIU) of the HK Police Force to streamline the processing of Suspicious Transaction Report using AI/ML, providing guidelines for implementing a large-scale anti-money laundering (AML) digital infrastructure.

- **Policy:**
  Drawing upon our in-depth study of seven fintech hubs, we offered a long-term roadmap with policy recommendations for Hong Kong in a report published in March 2022. According to the government's fintech strategy, multiple large-scale surveys on virtual banks, e-HKD, and virtual assets were conducted to provide relevant insights to the industry and policymakers.

- **Talent Development:**
  We produced a range of reports that provide strategies to address talent shortages in fintech. We developed initiatives like the ECF-Fintech (Professional Level) Program and the Cyberport Financial Practitioners FinTech Training Programme to enhance fintech education for industry professionals. A dedicated jobs and skills portal was built to bridge industry skill gaps.

- **Knowledge Exchange and Collaboration:**
  The project established a platform to foster collaborations among fintech companies, startups, financial institutions, and regulators. Joint research initiatives, such as a partnership with HSBC on e-HKD readiness, and a "Hypothetical e-HKD" pilot run at HKUST, were developed to promote the wider adoption of fintech.

研究影響

我們的學術成果在多方面提升了香港的金融科技能力：

- **對業界的影響：**
  我們利用新興技術開發了多個實用的應用程式，包括FinBERT和FinSent，並受到廣泛好評。我們亦與香港警務處聯合財富情報組 (JFIU) 合作，利用人工智能/機器學習技術簡化可疑交易報告的處理程序，為JFIU實施大規模反洗錢 (AML) 的數字基礎設施提供了指引。

- **政策：**
  總結本項目針對七個金融科技樞紐的深入研究，我們在2022年3月發布了一份行業報告，其中提出了一個香港金融科技發展的長期路線圖及政策建議。根據政府的金融科技發展戰略，我們亦進行了多項大型調查，主題涵蓋虛擬銀行、數碼港元 (e-HKD) 和虛擬資產，為業界和政策制定者提供相關資訊。

- **人才發展：**
  本項目發布了一系列人力資源研究報告，針對金融科技行業的人才短缺提供策略。我們開辦了多項人才培訓計劃，如銀行專業資歷架構 – 金融科技 (專業級) 計劃和數碼港金融從業員金融科技培訓計劃，以加強對行內專業人士的培訓。我們亦開發了一個針對新興行業的就業和技能網站，以彌合金融科技相關職業的技能差距。

- **知識交流與合作：**
  本項目建立了一個促進金融科技公司、初創企業、金融機構和監管機構之間合作和交流的平台。我們與企業合作展開不同的研究計劃，例如與匯豐銀行推行有關數碼港元 (e-HKD) 的聯合調查研究，和在科大校園進行的「假設性數碼港元」測試，以推動金融科技的廣泛應用。

Image-guided Automatic Robotic Surgery
視覺導航自動機械人手術

T42-409/18-R

Project Coordinator
Professor Yunhui LIU
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Participating Institutions
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Short Biography of Project Coordinator

Professor Yunhui Liu is currently Choh-Ming Li Professor of Mechanical and Automation Engineering, the Director of the CUHK T Stone Robotics Institute, and the Director/CEO of Hong Kong Centre for Logistics Robotics funded by the InnoHK clusters. He has published more than 500 papers in refereed journals and conference proceedings and was listed in the Highly Cited Authors (Engineering) by Thomson Reuters in 2013. His research interests include vision-based robotics, machine intelligence, and their applications in manufacturing, logistics, healthcare, and construction. Professor Liu has received numerous research awards from international journals and international conferences in robotics and automation and government agencies. In recent years, he has been actively transferring robotics technologies developed at university labs to industries and founded or co-founded VisionNav Robotics, CornerStone Robotics, and Zanecon Robotics. He is an IEEE Fellow and a HKAES Fellow.

項目統籌人簡介

劉雲輝教授現任香港中文大學工程學系卓敏機械與自動工程學教授，天石機械人研究所所長及 InnoHK 創新中心：香港物流機械人研究中心總監。劉教授已在國際著名專業期刊和國際會議上發表學術論文逾 500 篇，並於 2013 年被 Thomson Reuters 評為工程學領域“高被引作者”（Highly Cited Authors）。他的研究領域包括基於視覺的機械人控制、機器智能及其在智慧製造、物流、醫療及建築等行業的應用。劉教授曾多次榮獲來自國際期刊及政府機構的研究獎項。近年來，他積極將實驗室開發的機械人技術轉移到業界，並創立或共同創立了包括未來機器人（VisionNav Robotics）、康諾思騰（CornerStone Robotics）、築橙科技（Zanecon Robotics）在內的多家科技公司。劉教授亦獲選為國際電機電子工程師學會（IEEE）會士及香港工程科學院（HKAES）院士。

Project Summary

Development of crucial technologies for next-generation surgical robots with automation and intelligence functions to improve the safety and quality of robotic surgery.

Addressing scientific and technological challenges in sensing, perception, planning, safe motion control, and high-level intelligence of surgical robots.

Development of the state-of-the-art approaches/solutions to cope with real-time sensing, data-driven surgical planning, visually servoed robot controllers, and AI-based skill learning form surgical experts.

Validation of the technologies and the integrated robotic surgical systems in ex-vivo and or clinical trials.

Close collaboration among the local and international research institutions to establish a world-class surgical robotics research centre in Hong Kong.

項目概要

研發具有自動化及智能化功能的新一代手術機械人技術，提高手術機械人的安全性及質量

應對手術機械人在感知、規劃、安全運動控制和高級智能方面的科學和技術挑戰

開發前沿的解決方案，應對即時感知、數據驅動的手術規劃、機械人視覺伺服控制方法以及基於人工智能的專家技能學習

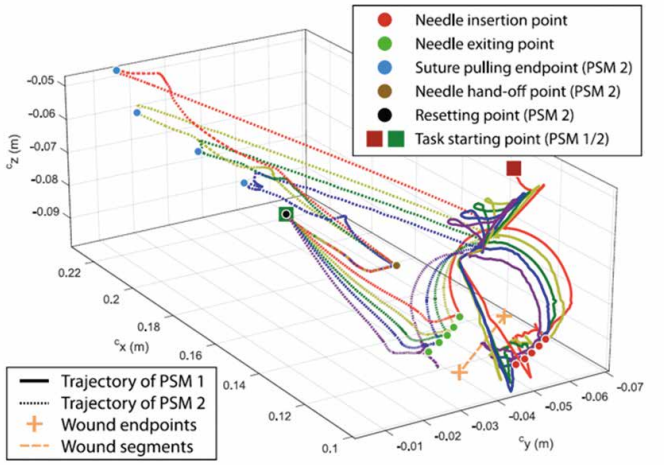
進行面向手術自主操作的體外試驗和臨床試驗，以驗證各項研究成果和集成的手術機械人系統

與香港本地和國際研究機構緊密合作，為香港建立世界級的手術機械人研究中心

Agilis flexible surgical robot

CSR Multi-port surgical robot and Agilis flexible surgical robot developed based on the outputs of the project
以該項目的研究成果為基礎，研發出康諾思騰多端口手術機械人及巧捷力靈活手術機械人

Multi-arm coordination for automatic tissue suturing using surgical robots
基於手術機械人的多臂自主軟組織縫合系統



Abstract

Existing surgical robots work in a remote-control mode, where a surgeon attentively tele-controls all the robots' motions. It is widely considered that they will be replaced by next-generation surgical robots that can assist surgeons with automation functions and surgical intelligence. The next-generation surgical robots are expected to effectively alleviate surgeons' physical and mental workload to reduce human errors and, hence, improve the overall quality of the surgery. This project aimed to develop state-of-the-art solutions to crucial technical problems, including real-time sensing, operative planning, instrument motion/action control, and surgical data analysis in semi-automated or automated robotic surgery. The research outputs have been integrated into surgical robotic systems, which were validated through cadaver experiments or clinical studies on human subjects. In addition to the academic research and technology development, parts of the research outputs have been commercialized by two startup companies spun off by the team members. The project could not have been completed successfully without close collaborations among the engineering experts, surgeons, local universities, and international institutions.

項目簡介

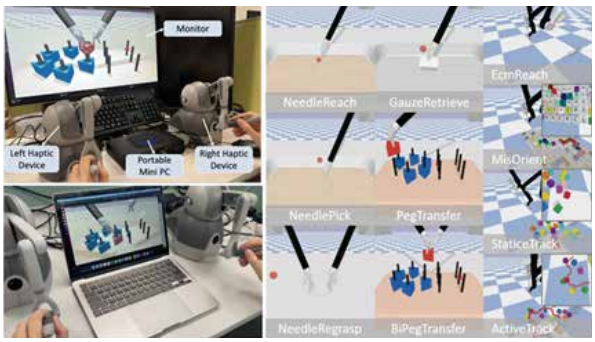
現時的手術機械人採用遠程控制模式進行手術，外科醫生需要全神貫注地遠程控制機械人的所有動作。人們普遍認為此技術將被新一代能夠為外科醫生提供關鍵協助的機械人所取代。自動化和智能化的機械人自主操作能夠有效減輕外科醫生的身心負擔，減少人爲錯誤，從而提高手術的質量。項目團隊致力研究針對關鍵技術問題解決方案，包括半自動或全自動手術機械人系統的實時傳感、術前規劃、術中控制和手術數據分析。團隊已將上述研究項目的成果集成至手術機械人系統，並通過展開屍體實驗和人體臨床研究進行應用驗證。除學術研究與技術開發，部分研究成果已由團隊成員創立的兩家衍生公司進行商業化落地。該項目所取得的成就得益於來自數個具有豐富工程和醫學背景的本地及國際大學之間的密切合作。

Research Impact

1) We have developed state-of-the-art technologies in sensing, planning, control and intelligence towards automated robotic surgery and the related intellectual properties, as evidenced by a large number of publications/presentations in the top journals or international conferences; 2) Commercialised parts of the research outputs via two startup companies, CornerStone Robotics Ltd and Agilis Robotics Ltd, which were established by the team members. The two startups have become leading players in multi-port surgical robots and miniature flexible surgical robots, respectively. 3) Developed the first one-surgeon-four-arms system and conducted the first clinical trials on AI-assisted semi-automated surgical robot; 4) The work has received international recognitions, as evidenced by the Best Paper award in medical robotics at the 2021 International Conference on Robotics and Automation etc.; 5) The research outputs largely contributed to the establishment of the InnoHK Centre: Multi-scale Medical Robotics Centre, which has been one of the leading centres in medical robotics in the world.

研究影響

1) 研發針對感知、手術規劃、控制和自動化手術機械人的前沿技術以及相關的知識產權，並在頂級期刊或國際會議上發表系列論文；2) 創立兩家衍生公司康諾思騰（CornerStone Robotics）和巧捷力（Agilis Robotics），以促進研究成果的商業應用。這兩家公司已分別成為多端口手術機械人和微型柔性手術機械人的領軍企業；3) 研發首個「一醫四手」外科機械人系統，並對人工智能輔助的半自動手術機械人開展了首次臨床試驗；4) 該項目獲得了包括 2021 國際機械人與自動化會議（ICRA）最佳論文獎等國際認可；5) 研究成果也進一步促成了 InnoHK 旗下醫療機械人創新技術中心的建立。該中心已成為世界領先的醫療機械人中心之一。



An open-source surgical robotic learning simulation platform
面向手術機械人運動學習的開源模擬平台

"One-surgeon-four-arm" semi-automatic human-robot surgery collaboration system
「一醫四手」半自動人機協同手術操作系統

Research and Development of Artificial Intelligence in Extraction and Identification of Spoken Language Biomarkers for Screening and Monitoring of Neurocognitive Disorders

以人工智能提取和鑑定口語生物標誌物供神經認知障礙篩查和監測的研究及技術開發

T45-407/19-N

Project Coordinator
Professor Helen MENG
The Chinese University of Hong Kong

Participating Institutions
The Hong Kong Polytechnic University
The Hong Kong University of Science and Technology

項目統籌人
蒙美玲教授
香港中文大學

參與院校
香港理工大學
香港科技大學

Short Biography of Project Coordinator

Professor Helen Meng is Patrick Huen Wing Ming Chair Professor of Systems Engineering and Engineering Management at The Chinese University of Hong Kong. She joined CUHK in 1998 and has served as Department Chairperson, as well as Associate Dean of Research for CUHK's Faculty of Engineering. Professor Meng has been leading various joint partnerships, including with Microsoft Research Asia (MSRA), MIT, Tsinghua University and Dr. Stanley Ho Medical Development Foundation. Her collaboration with MSRA led to CUHK's first engineering laboratory to achieve the national status of a Ministry of Education Key Laboratory. In 2019, her interdisciplinary team was awarded the first AI project under the HKSARG RGC Theme-based Research Scheme, which aims to develop AI technologies for screening dementia. In 2020, she led the establishment of CUHK's InnoCentre on AI, named Centre for Perceptual and Interactive Intelligence, and serves as Director.

Since 2019, Helen has been serving as head of curriculum development of the CUHK-HKJC AI4Future Project, leading the creation of Hong Kong's first pre-tertiary AI curriculum, with a focus on AI ethics. The AI4Future Project was recognized with the Gold Award of the Hong Kong ICT Awards Smart People Award 2021. The curriculum will be taught in all local secondary schools starting in 2024. Helen and her team have won many other awards, including the Gold and Silver medals of 49th International Exhibition of Inventions Geneva 2024, 2023 and 2024 INTERSPEECH Best Student Paper Award, the US National Academy of Medicine's Healthy Longevity Global Grand Challenge 2024, the First Prize of the international DialDoc@ACL 2022 Challenge, Hong Kong's SciTech Challenge 2021 Open Category Championship, 2019 IEEE SPS Leo Beranek Meritorious Service Award for service and leadership, etc. Helen has also served as the elected Editor-in-Chief of the IEEE Transactions on Audio, Speech and Language Processing, a top journal in her field. Helen is a Fellow of the IEEE, ISCA, HKIE and HKCS.

Project Summary

Designed and collected CU-MARVEL, a speech corpus from older adults with varying levels of cognitive functioning

Developed the Hong Kong Grocery Shopping Dialog Task for effective and ecologically valid cognitive assessment

Linked neural activity, cognitive deficits, and speech via fMRI using a novel movie-watching task

Built an automated pipeline for NCD screening using advanced spoken language technologies

Developed NCD screening apps with analytical and generative AI

Piloting NCD screening apps in community setting

項目統籌人簡介

蒙教授是香港中文大學禤永明系統工程與工程管理學系講座教授，她於 1998 年加入香港中文大學，並曾擔任系主任以及香港中文大學工程學院的研究副院長。蒙教授致力各種聯合合作，其中包括與微軟亞洲研究院（MSRA）、美國麻省理工學院、清華大學及何鴻燊博士醫療拓展基金會的聯合實驗室以及研究中心。她與 MSRA 合作成立的實驗室其後升格為中國教育部重點實驗室，成為香港中大首例。

2019 年，她領導的的跨學科團隊成功獲得香港特區政府研究資助局主題研究計劃下的首個人工智慧項目，開發認知障礙症篩檢的 AI 技術。2020 年，她創辦了香港中文大學的人工智慧創新中心 - 博智感知互動研究中心有限公司，並擔任總監一職。自 2019 年以來，蒙教授擔任中大賽馬會「智」為未來計畫的課程發展負責人，主導開發香港首個以人工智慧倫理為重點的大學前人工智慧課程。此「AI4Future」計畫在 2021 年榮獲香港資訊及通訊科技獎「智慧市民獎」金獎。該課程於 2024 年起在全港中學推行。蒙教授及她的研究團隊獲獎甚多，近期獎項包括第 49 屆 2024 年日內瓦國際發明展金獎及銀獎、2023 及 2024 INTERSPEECH 最佳學生論文獎、2024 年美國國家醫學院健康長壽全球大挑戰獎項、國際比賽 DiaDoc@ACL 2022 第一獎、香港 SciTech Challenge 2021 公開組冠軍、2019 年 IEEE SPS Leo L. Beranek 功勳服務獎等。蒙教授曾被選為 IEEE SPS Transaction on Audio，Speech and Language Processing（被譽為是該領域最負盛名的期刊）的總主編，同時也是 IEEE、ISCA、HKIE 和 HKCS 的會士。

項目概要

設計並收集 CU-MARVEL 語料庫，涵蓋不同認知功能水準的長者語音資料。

設計香港購物對話任務，用於具有生態效度的有效認知評估。

透過 fMRI 結合創新的觀影任務，建立了神經活動、認知缺陷與語言的關聯性。

建立使用先進語言技術的 NCD 篩選自動化流程。

開發結合分析性和生成性 AI 的 NCD 篩查應用程式。

於社區環境中試行 NCD 篩查應用程式。

The inter-disciplinary and inter-university team for the project: (front-left) Professor XM Gong (CU), Professor XX Wu (CU), Professor Thomas Lam (CU), Professor Bonnie Lam (CU), Professor Brian Mak (HKUST), Professor MW Mak (PolyU), Professor Helen Meng (CU), Professor Vincent Mok (CU), Professor Helene Fung (CU), Professor Timothy Kwok (CU), Professor Diana Lee (CU), Professor XJ Ma (HKUST), Professor Kelvin Tsoi (CU), Professor Andrew Liu (CU, absent), Professor Patrick Wong (CU, absent) and Professor Jean Woo (CU, absent); (upper) students, postdoctoral, research assistants and supporting staffs.
跨學科及跨大學的計劃團隊：(前排左起) 龔先旻教授 (中大)、吳錫欣教授 (中大)、林遠東教授 (中大)、林賢嘉教授 (中大)、麥鑑榮教授 (科大)、麥文偉教授 (理大)、蒙美玲教授 (中大)、莫仲棠教授 (中大)、馮海嵐教授 (中大)、郭志銳教授 (中大)、李子芬教授 (中大)、麻曉娟教授 (科大)、蔡錦輝教授 (中大)、劉循英教授 (中大、缺席)、黃俊文教授 (中大、缺席)、胡令芳教授 (中大、缺席) ; (後排) 研究生、博士後、研究人員及支援職員

Abstract

Population ageing is a global issue. The WHO projects that by 2050, 22% of the world's population will be aged 60 or older, with Hong Kong's population aged 65+ rising to 35%. Population ageing is associated with high-burden geriatric syndromes, increasing public healthcare costs and threatening societal sustainability due to a shrinking workforce and tax base. Neurocognitive disorders (NCD), including dementia, are especially prevalent among older adults, with care costs estimated at USD 1 trillion today, expected to double by 2030. Effective disease screening and management are crucial. Current NCD diagnoses rely on clinical professionals using neuropsychological tests, which are limited by clinician shortages, subjective assessments, and cultural biases. To address these issues, an automated, objective evaluation platform will be developed using inexpensive spoken language biomarkers for NCD screening and monitoring. This platform will enable remote monitoring, generating patient alerts for timely treatment. Collecting individualized data over time will help detect early cognitive decline, improving disease management and reducing care costs. Spoken language biomarkers will be targeted, as they are non-intrusive and can be easily captured remotely. AI-driven technologies will extract these biomarkers, providing sensitive cognitive assessments. This research aligns with WHO's goals and aims to support patients and caregivers in Hong Kong through AI-enabled healthcare.

項目簡介

人口老化是一個全球性問題。根據世界衛生組織預測，到 2050 年，全球 60 歲以上人口將佔 22%，而香港 65 歲以上人口將上升至 35%。老化伴隨著高負擔的老年綜合症，增加了公共醫療費用，並由於勞動力和稅基的縮小而威脅到社會的可持續性。神經認知障礙 (NCD)，包括失智症，在老年人中尤其普遍，目前護理成本估計為 1 兆美元，預計到 2030 年將翻倍。有效的疾病篩檢和管理至關重要。目前的 NCD 診斷依賴臨床專業人員使用神經心理測試，受限於醫生短缺、主觀評估和文化偏見。為解決這些問題，本項目將開發一個基於廉價生物標記的 自動化、客觀評估平台，用於 NCD 篩檢和監測。該平台將實現遠端監測，產生患者警報以便及時治療。透過長期收集個人化數據，有助於早期檢測認知衰退，提高疾病管理水平，並降低照護成本。口語語言生物標誌物會成爲提取目標，因為它們具有非侵入且易於遠端捕獲的特性。透過 AI 技術提取這些生物標誌物，提供敏感的認知評估。這項研究與世界衛生組織的目標一致，旨在透過 AI 支持的醫療保健幫助香港的患者和照護者。

Research Impact

This project addresses the growing prevalence of neurocognitive disorders (NCDs) in an aging global population, with the 60+ demographic set to double by 2050. In Hong Kong, over 100,000 older adults may go undiagnosed due to long wait times and high care costs. We develop AI-driven spoken language analysis technologies for automated, non-intrusive NCD screening, offering cost-effective, scalable, and accessible cognitive assessments. With the CU-MARVEL corpus, the largest for NCD research in Hong Kong, we advanced deep learning for spoken language biomarkers. Integrating speaker diarization, speech recognition, and NLP, we created an AI-enabled screening pipeline with strong results in both English and Cantonese. Novel tasks like the Hong Kong Grocery Shopping Dialog and fMRI movie-watching have improved screening via memory and communication. Our screening apps are being piloted in the community. This work aligns with important initiatives such as Healthy China 2030 Blueprint, WHO's Global Action Plan on Dementia, and the UN's 2030 Agenda for Sustainable Development by enhancing healthcare access and reducing inequalities.

研究影響

這個計劃應對了全球人口老化過程中神經認知障礙 (NCDs) 日益增長的嚴重問題，預計到 2050 年，60 歲以上人口將翻倍。在香港，由於漫長的候診時間和高昂的醫療費用，超過 10 萬名老年人可能無法及時確診。我們開發了基於 AI 的語言分析技術，用於自動化、非侵入式的 NCD 篩檢，提供具有成本效益、可擴展且易於取得的認知評估。透過香港最大的 NCD 研究語料庫 CU-MARVEL，我們推動了語言生物標記的深度學習研究。透過整合說話者分離、語音辨識和自然語言處理 (NLP)，我們創建了一個支援 AI 的篩檢管道，在英語和粵語中均取得了出色成果。像是香港購物對話任務和 fMRI 觀影任務這樣的新穎任務，改善了對記憶和溝通的篩選。我們的篩檢應用程式目前正在社區中進行試點。該工作與《健康中國 2030 藍圖》、世界衛生組織的《腦退化全球行動計劃》和聯合國《2030 年永續發展議程》等重要倡議保持一致，旨在提升醫療服務的可及性並減少不平等現象。

Demonstration for the project's app in the CUHK Medical Centre Innovation Week (December 15, 2023)
在香港中文大學醫院創新週活動中公開展示計劃的應用程式

Awarded Silver Medal in the 49th International Exhibition of Inventions Geneva 2024
榮獲 2024 年第 49 屆日內瓦國際發明展銀獎


A Citi Lecture Theater (LT-A) 花旗集團演講廳
B Lam Woo Lecture Theater (LT-B) 林護演講廳
C Padma and Hari Harilela Lecture Theater (LT-C) 夏利萊博士及夫人演講廳
D Lee Wing Tat Lecture Theater (LT-D) 利榮達演講廳
E Cheung On Tak Lecture Theater (LT-E) 張安德講堂
F Leung Yat Sing Lecture Theater (LT-F) 梁日盛講堂
G Chow Tak Sin Lecture Theater (LT-G) 周德新講堂
H Chen Kuan Cheng Forum (LT-H) 陳冠貞論壇
J Chiang Chen Lecture Theater (LT-J) 蔣震演講廳
K Mr and Mrs Lee Siu Lun Lecture Theater (LT-K) 李兆麟伉儷演講廳
L CMA Lecture Theater (LT-L) 香港中華廠商聯合會演講廳
Lifts in Academic Building 教學大樓電梯
Lifts in Lee Shau Kee Campus 李兆基校園電梯
Souvenir Center 紀念品中心
Mr and Mrs Ho Ting Sik Visitor Information Center 何廷錫伉儷訪客資訊中心
Tang Shiu Kin Computational Laboratory 鄧肇堅電腦廳
Security Center 保安中心
Bookstore 大樓書店
Bank 銀行
* Caterers' opening hours are subject to change.
Fok Ying Tung Sports Center 霍英東體育中心
Coastal Marine Lab 海岸海洋實驗室
American Diner*
LG1, LG5 & LG7 Canteens* Supermarket
China Garden Restaurant*, G/F
Lee Shau Kee Library 李兆基圖書館
The Hong Kong Jockey Club Atrium 香港賽馬會大堂
Tsang Shiu Tim Art Hall 曾肇添展藝廊
Coffee Shop*
Chia-Wei Woo Academic Concourse 吳家瑋學術廊
S H Ho Sports Hall 何善衡體育館
Starbucks Coffee*
ATM
Piazza 廣場
North Entrance 北門入口
Bus 巴士:
91M → Po Lam 寶琳
91 → Clear Water Bay 清水灣
792M → Tseung Kwan O / Sai Kung 將軍澳/西貢
Minibus 小巴:
11/11M → Hang Hau 坑口
12 → Po Lam / Sai Kung 寶琳/西貢

HKUST Campus Map
香港科技大學校園地圖

Organizers 主辦機構

大學教育資助委員會
University Grants Committee

香港科技大學
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

Collaborating Universities 協辦大學

香港中文大學
The Chinese University of Hong Kong

THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

香港大學
THE UNIVERSITY OF HONG KONG