

電子及計算機工程學系 DEPARTMENT OF ELECTRONIC & COMPUTER ENGINEERING



AI & Healthy Aging

Bert Shi, Professor and Director, eebert@ust.hk







M Y Ni et al., Understanding longevity in Hong Kong: a comparative study with long-living, high-income countries, The Lancet Public Health, Volume 6, Issue 12, 2021. <u>https://doi.org/10.1016/S2468-2667(21)00208-5</u>, (<u>https://www.sciencedirect.com/science/article/pii/S2468266721002085</u>)</u>

香港科技大學 THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY 電子及計算機工程學系 DEPARTMENT OF ELECTRONIC & COMPUTER ENGINEERING CENTER FOR AGING SCIENCE







Note: all figures exclude foreign domestic helpers Source: Census and Statistics Department

Population ageing is expected to continue. With post-war baby boomers entering old age and the rising life expectancy at birth for both sexes, the number of elderly persons aged 65 and over is projected to nearly double over the 25-year period. Excluding foreign domestic helpers, the number of elderly persons will increase from 1.45 million in 2021 to 2.74 million in 2046. The corresponding proportion of the population is projected to increase from 20.5 per cent to 36.0 per cent, meaning more than one in every three Hong Kong people will be an elderly.

K.-C. Ng, "Hong Kong's population will be a little smaller, a lot grever by 2069,

Meanwhile, Hong Kong's fertility rate is expected to remain low. The total fertility rate (i.e. the number of children born alive to 1 000 women during their lifetime) is projected to rebound slightly from 772 in 2021 to 938 in 2046.

 香港科技大學 THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY 電子及計算機工程學系 DEPARTMENT OF ELECTRONIC & COMPUTER ENGINEERING







SUSTAINABLE GOALS



香港科技大學 THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY 電子及計算機工程學系 DEPARTMENT OF ELECTRONIC & COMPUTER ENGINEERING CENTER FOR AGING SCIENCE





The Center for Aging Science aims to develop and foster a better understanding of healthy aging, promote the idea of balancing physical and psychological health, as well as sustaining relationships in old age. We aspire to be the leading center of aging science in Hong Kong.

Interdisciplinary	The aging research within HKUST is highly interdisciplinary and focuses on the understanding of the science of aging, from genomic data analysis, social impacts of aging, operations and decision analytics research to development of technology-based solutions for the betterment of healthy aging.
Pragmatic	HKUST is dedicated to enhancing the quality of life of the aging population in Hong Kong and beyond. We do this through our research and by engaging with leading elderly care facilities such as Haven of Hope Christian Service (HOHCS), and regularly collaborating with local hospitals.
Visionary	Through this interdisciplinary and holistic platform, HKUST is committed to focus on our strengths in science and technology. Besides addressing aging population issues, we believe it is important to engage younger generations in understanding the science of healthy aging and learning their important role in this aging society.







Adaptation:

Improving wellbeing for those in need today

Mitigation:

Improving the current and future condition of people who have already had many aspects of their life-course in train

Resilience:

Ensuring the youngest in society age well and can maximise their social and economic potential

電子及計算機工程學系 DEPARTMENT OF ELECTRONIC & COMPUTER ENGINEERING



Quintuple Aim for Health/Health Care



Matheny, M., S. Thadaney Israni, M. Ahmed, and D. Whicher, Editors. 2022. Artificial Intelligence in Health Care: The Hope, the Hype, the Promise, the Peril. Washington, DC: National Academy of Medicine.

電子及計算機工程學系 DEPARTMENT OF ELECTRONIC & COMPUTER ENGINEERING



Projects in Social Sciences & Business

- Promoting well-being in the community through writing interventions: The role of emotion beliefs and work ideology (Melody CHAO, MGMT)
- Building a population health and wellbeing data ecosystem for Hong Kong (Stuart GIETEL-BASTEN, SOSC)
- Migrant Domestic Workers and the Market for Elderly Care Services in Hong Kong (Sujata VISARIA, ECON)
- The effect of aging on language learning and consolidation: a case study on Cantonese-speaking older adults (Quentin QIN, HUMA)
- Towards a more inclusive Hong Kong: COVID-19, mental well-being, and mitigation strategies for a multicultural elderly community (Naubahar SHARIF, PPOL)







South China Morning Post



Hong Kong / Society

Hong Kong will need 600,000 domestic helpers in next 30 years amid demand for elderly care, labour chief says

Adding to complexities is the concern that wider hiring policies and better wages on the mainland will cause exodus of such workers from city

Foreign domestic workers in Hong Kong + FOLLOW



T Why you can trust SCMP

Abbreviations: MGMT = Management SOSC = Social Sciences ECON = Economics HUMA = Humanities PPOL = Public Policy



- Screening of Dementia in the Hong Kong Chinese Population (Nancy IP, LIFS)
- A novel cancer drug discovery platform using singlecell multi-omic technology (Angela WU, LIFS/CBE)
- Rejuvenation of aged tissue by conserved mechanisms that preserve youthful peroxisomes (Ho Yi MAK, LIFS)
- Deciphering MAPT Mutation-Induced Aberrant RNA Splicing and Altered Protein Homeostasis in Alzheimer's Disease by Integrated Proteogenomic Approach (Shaojun TANG, BSBE (GZ))
- To investigate how aging influences glaucoma pathogenesis (Ting XIE, LIFS)



科技大學 IONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

電子及計算機工程學系 DEPARTMENT OF ELECTRONIC & COMPUTER ENGINEERING







THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

arch team led by HKUST has developed a simple but robust blood test from Chinese ent data for early detection and screening of Alzheimer's disease (AD) for the first time, with an a

Q =



10

Q =

O SEARCH



۸lzhoimo	Electronic Health Record	Speech Analysis Emotior	Video Hu Analysis U	man Behavi nderstandin	or g
Detectio	n N	Recogniti	on Hu	man E	ye-Gaze
3D Mapping	g Analysis	ge Artific	ial Com Inter	nputer ^{Pl} raction	Population
Incident V Detection C	/isual ontrol Rob	otics	Machine	Voice Agent	Conceptual
Dynamic Environment Modeling	Autonomous Driving	Facial	Learning Dialogue	Virtual Assistant	Approach to Ageing
Near-Infi	rared	cognition	System	ASSIStant	Fertility Transition
Spectros	copic Binaural Hearing	Remote The Screenin	ermal Remo g Mo	te Vital Sign onitoring	
onthe Hong Kong University of S	電子及計 CIENCE AND TECHNOLOGY	- 算機工程學系 T OF NIC & COMPUTER ENGINEERING	CENTER FOR AGING SCIENCE		11

Use Case or User Group	Category	Examples of Applications	Technology
Patients and families	Health monitoring Benefit/risk assessment Disease prevention and management	 Devices and wearables Smartphone and tablet apps, websites Obesity reduction Diabetes prevention and management Emotional and mental health support 	Machine learning, natural language processing (NLP), speech recognition, chatbots Conversational artificial intelligence (AI), NLP, speech recognition, chatbots
	Medication management Rehabilitation	Medication adherenceStroke rehabilitation using	Robotic home telehealth Robotics
Clinician care teams	Early detection, prediction, and diagnostics tools	 apps and robots Imaging for cardiac arrhythmia detection, retinopathy Early cancer detection 	Machine learning
	Surgical procedures	 (e.g., melanoma) Remote-controlled robotic surgery AI-supported surgical roadmaps 	Robotics, machine learning
	Precision medicine Patient safety	Personalized chemotherapy treatmentEarly detection of sepsis	Supervised machine learning, reinforcement learning Machine learning
		帚乙马针管烨丁程朗 亥	*

重 THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

電子及計算機工程學系 DEPARTMENT OF ELECTRONIC & COMPUTER ENGINEERING CENTER FOR AGING SCIENCE Matheny, M., S. Thadaney Israni, M. Ahmed, and D. Whicher, Editors. 2022. Artificial Intelligence in Health Care: The Hope, the Hype, the Promise, the Peril. Washington, DC: National Academy of Medicine.

Use Case or User Group	Category	Examples of Applications	Technology
Public health program managers	Identification of individuals at risk Population health	Suicide risk identification using social mediaEldercare monitoring	Deep learning (convolutional and recurrent neural networks) Deep learning, geospatial pattern mining, machine learning
	Population health	 Air pollution epidemiology Water microbe detection	Deep learning, geospatial pattern mining, machine learning
Business administrators	International Classification of Diseases, 10th Revision coding	• Automatic coding of medical records for reimbursement	Machine learning, NLP
	Fraud detection	Health care billing fraudDetection of unlicensed providers	Supervised, unsupervised, and hybrid machine learning
	Cybersecurity	 Protection of personal health information 	Machine learning, NLP
	Physician management	• Assessment of physician competence	Machine learning, NLP
Researchers	Genomics Disease prediction Discovery	Analysis of tumor genomicsPrediction of ovarian cancerDrug discovery and design	Integrated cognitive computing Neural networks Machine learning, computer- assisted synthesis



Matheny, M., S. Thadaney Israni, M. Ahmed, and D. Whicher, Editors. 2022. Artificial Intelligence in Health Care: The Hope, the Hype, the Promise, the Peril. Washington, DC: National Academy of Medicine.



Abbreviations:

CBE = Chemical and Biological Engineering ISD = Integrated Systems Desing ECE = Electronic and Computer Engineering CSE = Computer Science and Engineering

- UGOD (GZ) = Urban Governance and Design (Guangzhou Campus)
- Task-specific Ionic Liquids for Enhanced Capture and Inactivation of Infectious Droplets and Aerosols (King Lun YEUNG, CBE)
- Sensing and Assessing Dementia Patients' State in Smart Environments (Tristan BRAUD, ISD)
- Humanoid Robotic Healthcare Assistant (Bert SHI, ECE)
- New Technologies to Support the Recovery of Respiratory Mobile Device Based Lung Function Assessment and Breathing Exercise Mentoring (Qian ZHANG, CSE)
- Virtual life space intervention to slow the progression of Alzheimer's disease and to speed the recovery of COVID brain fog (Ge Lin KAN, UGOD (GZ))
- XAID: Explainable Artificial Intelligence for Alzheimer's Disease Diagnosis and Progression Quantification from Multi-Modality Data (Hao CHEN, CSE & CBE)







Humanoid Healthcare Assistant

Collaborators:









- Background
 - Only 44% of healthcare worker's time spent helping patients (SOTI, 2021)
 - Documentation and patient transfer waste the most time (Lankarani et al. 2019)
- Goal
 - Increase the percentage of time that healthcare workers can spend on helping patients
 - Humanoid robotics for tasks distracting healthcare workers from patient care







AWAKENING HEALTH HANSON

- Provide robot hardware platform
- Develops worlds most human-like robots
- Have identified healthcare as priority





- Assistance with system design
- Nursing staff for system testing
- On-site testing









- Assessment of patient orientation
 - via the AMT questionnaire
 - carried out by nurses and occupational therapists
- Patrol task
 - Grace to monitor wards at night.
 - Detect dangerous situations, e.g. risk of falls, and relay information back to nurses

QUESTION		Date	Date	Date
		SCORE (Please circle the SCORE)		
1.	你現在幾多歲?(±5年)	1/0	1/0	1/0
	Age (± 5 year)			
2.	現在是幾點鐘?	1/0	1/0	1/0
	Time (nearest hour, or $a / p / n$)			







- Hype vs hope
- Potential problems with models
 - Sensitivity to mismatch between training and deployment data
 - Difficult to correct for biases
 - Temptation to treat predictors as factors that can be manipulated to change outcomes.









- Bias: AI systems may amplify or exacerbate what people are already doing, irrespective of whether that is good or bad."
 - Note: bias is not inherently undesirable, ideally care decisions are biased towards the best outcomes
- Transparency
 - Consent for use of data
 - Danger of re-identification
 - Use of data for model development and publication







Forms of Transparency

1. ... Explainability: How does the algorithm reach its results?
 010011 Dataset: Where did the data

Dataset: Where did the data come from, and how were they processed?



000101

001101

Algorithmic: How was the algorithm developed and validated?



Architecture: How do the pieces of the AI system work together?



- Data breaches and ransomware attacks
- Privacy concerns vs. benefits to the public good arising from generalizing from large amounts of data.
- Adversarial Attacks





Hong Kong / Law and Crime

Hong Kong tech hub Cyberport alerts police, privacy watchdog after reports of ransomware attack exposing 400GB of data

- Social media report claims ransomware group Trigona has targeted
 Cyberport
- Cyberport says it has shut down affected computer equipment and conducted investigation with cybersecurity experts

Crime in Hong Kong + FOLLOW

Danny Mok and Ezra Cheung Published: 10:33am, 7 Sep. 2023

T Why you can trust SCMF







港科技大學 THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY DEPARTMENT OF ELECTRONIC & COMPUTER ENGINEERING

are jobs to computerisation?, Technological Forecasting and Social Change, vol. 114,



Future role of clinicians

- Will clinical professions eventually evolve into glorified data entry clerks, or will AI techniques free them to focus on direct care and fostering human relationships.
- How will democratization of medical information, e.g., via chatbots, affect trust in medical professionals?
- Deskilling: will clinicians lose "core competencies"?
 - AI may have a role in training





- Identify synergy, rather than replacement.
 - How to split tasks between AI and Human
 - How to integrate AI into existing or improved workflows
- Use automated systems to reach patients who do not currently have access to adequate healthcare





