List of funded projects led by CUHK researchers

1. **Professor Xing Guoliang, Professor in the Department of Information Engineering**
   Project title: Foundation Models-Empowered Ambient Intelligence Systems for Early Diagnosis, Personalised Intervention, and Complex Cross-Disease Interplay Analysis of Aging-Related Degenerative Diseases

   Ageing-related degenerative diseases like dementia and sarcopenia pose significant global health challenges. These conditions increase the risk of mobility disorders, cognitive impairment, institutionalisation and death. Recent evidence highlights their complex interplay. This project introduces Koala, the first ambient intelligence system using Foundation Models (FM) to provide non-invasive, personalised diagnosis, intervention and cross-disease analysis for these diseases. First, the team will develop a multi-modal sensor system for elderly homes to monitor health activities and digital biomarkers, and facilitate natural interactions via voice and gesture. Next, it will develop KoalaFM, a trustworthy and efficient FM for dementia and sarcopenia, integrating heterogeneous data from digital biomarkers, medical reports and consultation logs. It will propose novel approaches to the discovery of new biomarkers, early diagnosis, personalised interventions and enhanced clinical assessments. A large-scale clinical trial with 1,000 subjects from three hospitals in Hong Kong will validate Koala, making it the largest cross-disease cohort study of dementia and sarcopenia. This study aims to provide holistic health solutions and insights into the complex interplay of ageing-related degenerative diseases, improving diagnostic and therapeutic approaches.

2. **Professor Vincent Cheung Chi-kwan, Associate Professor in the School of Biomedical Sciences**
   Project title: Personalised Rehabilitation Pathways to Maximal Motor Functional Return through an AI Recovery Prediction System for Diverse Stroke Survivors

   This project aims to address the challenges of providing adequate motor rehabilitation to stroke survivors in Hong Kong, amid an ageing population, younger onset of stroke and a shortage of therapists. Stroke is the leading cause of adult disability in Hong Kong and the third globally. To reduce the socioeconomic burden, rehabilitation efficacy and efficiency must improve. The team plans to develop an AI system (nicknamed PRAISE-HK) based on multi-modal pre-rehabilitation assessments to predict recovery potential and optimal treatment for stroke survivors. The team will collect clinical, neuroimaging, neurophysiological and multi-omics data from 200-400 subacute stroke survivors, who will undergo treatments including conventional upper limb rehabilitation, acupuncture, robotic training and neuromuscular stimulation. Machine learning-extracted features from these data will be used to train algorithms for robust recovery predictions. After the system is validated, the team will implement a pilot personalised rehabilitation programme in the community. The interdisciplinary team, comprising investigators from CUHK, HKBU, CityU, PolyU, and Australia, has expertise in neurology, PT/OT, acupuncture, engineering, data science and more. In the long run, PRAISE-HK will accelerate marketisation of new rehabilitative strategies by facilitating their clinical-trial evaluation in more targeted populations, attracting rehabilitation scientists worldwide to Hong Kong, and establishing it as a global hub for innovative rehabilitation.

3. **Professor Tsang Hon-ki, Dean of the Faculty of Engineering and Wei Lun Professor of Electronic Engineering**
   Project title: Silicon Photonics and the Heterogeneous Epitaxy of III-V Semiconductors on Silicon for Advanced Photonic Systems-on-chip

   With the imminent breakdown of Moore's law (which predicts that the number of transistors on a microchip doubles approximately every two years) because of increased technical challenges and costs, the team proposes an alternative pathway to enhance integrated systems-on-chips (SoCs) using photonic integration on silicon. This project aims to develop core technologies for advanced Photonic Systems-on-Chips (PSoCs). Photonic integration, which processes photons instead of electrons, offers significant advantages in optical sensing, data communications and high-speed signal processing. Silicon is used for its low-cost, high-yield benefits from CMOS manufacturing, high reliability and established supply chains. The team will research a new process for the heteroepitaxial integration of III-V semiconductors on silicon, using Lateral Aspect Ratio Trapping (LART) to avoid thick buffer layers and enable efficient light coupling. This project will develop basic integration processes and demonstrate PSoCs' advantages in compact imaging systems, energy-efficient photonic signal processors, and integrated light sources for sensing and communications. The project will fabricate new III-V photonic devices on silicon, including lasers, LEDs, modulators, amplifiers and photodetectors, integrating them with high-performance passive silicon photonic elements. The goal is to create PSoCs for high-capacity optical interconnects, high-speed imaging systems, photonic accelerators and other emerging applications.