Appendix 1

Project Information

Cable-driven Inspection Robot for High-rise Building Façade

Working at height is one of the major risks faced by construction workers. According to the Occupational Safety and Health Statistics 2021 report from the Hong Kong government's Labour Department, there were more than 200 occupational injuries in the construction industry caused by people falling from heights in 2021. Professor Darwin Lau Tat-ming, Assistant Dean (Student Affairs) in the Faculty of Engineering and Associate Professor in the Department of Mechanical and Automation Engineering at CUHK, has developed the Cable-driven Inspection Robot for High-rise Building Façade to address the risk of working at height. The mobile cable robot system can perform contact-based façade inspections. It consists of four components: 1) one or more mobile carriers with cable-driven robot winches; 2) cable-driven robots to move the inspection end-tool; 3) an end-effector platform with inspection tools and stabilisation; and 4) digital recording and data analysis of the building's health.

The system can conduct robotic inspections using automatic, precise inspection sensors. It also generates intuitive inspection results with 3D point cloud models through photogrammetry and is compatible with various modules that help it to perform different façade operations, including cleaning, painting and pipe installation. Some local construction companies have cooperated with the research team to conduct site trials of the system. The project also received a Silver Medal at the International Exhibition of Inventions Geneva 2022.

About Professor Darwin Lau Tat-ming

Professor Lau received Bachelor of Engineering (mechatronics) and Bachelor of Computer Science degrees from the University of Melbourne, in 2008, and a Ph.D. in robotics from the University of Melbourne in 2014 on the modelling and analysis of anthropomorphic musculoskeletal cable-driven robots. From 2014 to 2015, he was a postdoctoral research fellow at ISIR, Université Pierre et Marie Curie, Paris, on humanoid predictive control walking algorithms. Currently, he is the Assistant Dean (Student Affairs) in CUHK's Faculty of Engineering, Associate Professor in the Department of Mechanical and Automation Engineering, and the co-director of the CUHK Centre of Robotic Construction and Architecture. Notable awards received by Prof Lau include the University of Melbourne Chancellor's Prize for Excellence in the PhD Thesis, the CUHK University Education Award and the Hong Kong University Grants Committee Teaching Award (Early Career Faculty Members).

Deep Learning for Trading and Risk Management

Financial transactions nowadays no longer rely solely on economic theory, but also involve a range of other disciplines. A research team led by Professor Wong Hoi-ying, Associate Dean (Student Affairs) in the Faculty of Science and Professor in the Department of Statistics at CUHK, has successfully adopted deep learning models to develop tools for extracting useful trading signals and predicting stock movements. For intraday trading, the research team has developed a novel Deep Limit Order Book (LOB) trading system that takes advantage of tick-time intervals with deep learning and GPU techniques to generate trading signals. The system can also optimise these signals and execute orders to make profits under real trading circumstances. For interday trading, the team also uses numerous inputs to build deep learning models that can predict trading signals.

The model can deal with large and high-dimensional data sets using deep learning and GPU techniques, extracting useful information and predicting stock movements. The model also incorporates the "focal loss function" and "fractional Kelly growth criterion under VaR control" for statistical analysis and decision-making.

About Professor Wong Hoi-ying

Professor Wong obtained his B.Sc. with first class honours in mathematical sciences from Hong Kong Baptist University in 1997 and his Ph.D. in mathematics from the Hong Kong University of Science and Technology in 2001. He joined CUHK the same year and was a founding Co-Director of the Quantitative Finance and Risk Management programme and Director of the MSc in Risk Management Science programme. He received the Vice-Chancellor's Exemplary Teaching Award twice, in 2015 and 2020, as recognition of his outstanding contribution to teaching.

Novel Injectable Scaffold for Treating Osteoporotic Bone Defects

Existing calcium-based cement augmentation products exhibit excessively slow biodegradation, which may impede bone regeneration. To address these drawbacks, a research team led by Professor Ngai To, Assistant Dean (Research) in the Faculty of Science and Professor from the Department of Chemistry at CUHK, has developed a novel hierarchical porous Magnesium oxychloride cement foam (MOCF)-derived scaffold with a more appropriate bio-resorption kinetic and superior bioactivity for bone defect repair.

The MOCF shows excellent handling performance in a paste state while exhibiting sufficient load-bearing capacity after solidification. It has been proven to enhance osteogenesis in animal studies. Compared with the traditional calcium-based bone cement, the MOCF scaffold demonstrates a much higher biodegradation tendency and better cell recruitment ability. It is anticipated that it will be a competitive clinical therapy to augment osteoporotic bone regeneration.

About Professor Ngai To

Professor Ngai obtained his B.Sc. with first class honours and his Ph.D. in Chemistry from CUHK in 1999 and 2003 respectively. He then pursued his postdoctoral training in Germany and the US before joining CUHK as a Research Assistant Professor in 2006. Professor Ngai received the Croucher Fellowship in 2003, and has also received many other teaching and research awards, including the Faculty Exemplary Teaching Award, the Research Excellence Award and the Young Researcher Award. He was selected as a Fellow of The Royal Society of Chemistry (FRSC) in 2018. His research interests focus on various areas of surface and colloid science.