INNOVATION FOR BETTER LIFE

2011-2012

香港中文大學

The Chinese University of Hong Kong

PREFACE 序言

Thank you for your interest in the innovations of The Chinese University of Hong Kong (CUHK). Founded in 1963, CUHK is a forward looking comprehensive research university. Like all great research universities in the world, CUHK has the mission to create, preserve and disseminate knowledge. Furthermore, we have committed ourselves not only to advancing academic research but also upholding the public service.

We would like to share with you some of the recent research results through this booklet. One of our goals is to support university technology transfer to the industry. Direct commercialization of university research results is an effective way to facilitate industrial innovation, thereby contributing to the migration of Hong Kong towards a knowledge-based economy.

To reduce paper consumption, we only provide abstract of our projects here. Detailed information can be found from the following website:
www.cintec.cuhk.edu.hk/exhibition

If you are interested in our projects, please contact us,
by phone: (852) 3943 8221 or email: enquiry@cintec.cuhk.edu.hk.

Prof. WONG Kam Fai
Director
Centre for Innovation and Technology
The Chinese University of Hong Kong

感謝您對香港中文大學(中大)創意發明的興趣，中大於1963年成立，是一所具前瞻性的研究型綜合大學，與世界上其他卓越的研究型大學一樣，中大承擔起創造、保存和傳播知識的使命，而且，我們不僅致力促進學術研究，更不遺餘力地服務社會大眾。

透過此刊物，我們希望與您分享中大最新的科研成果。我們其中一個目標，是支援業界轉移大學的科技至應用層面，使大學的科研成果商品化，這是帶動業界取得創新科技的有效途徑，有助推進香港轉型為知識型經濟體系。

為減少用紙，我們只提供研究項目摘要，詳細資料請瀏覽以下網址：
www.cintec.cuhk.edu.hk/exhibition

如您對任何項目感興趣，請聯絡我們，電話：(852) 3943 8221或電郵：enquiry@cintec.cuhk.edu.hk。

香港中文大學
創新科技中心主任
黃錦輝教授

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信息和通訊科技 Information & Communication Technologies

機械人及自動化技術 Robotics & Automation

生物醫藥科學
Biomedical Sciences

Centrifugal Microfluidics Platforms for Bioassay Automation
離心微流控生物測定自動化平台

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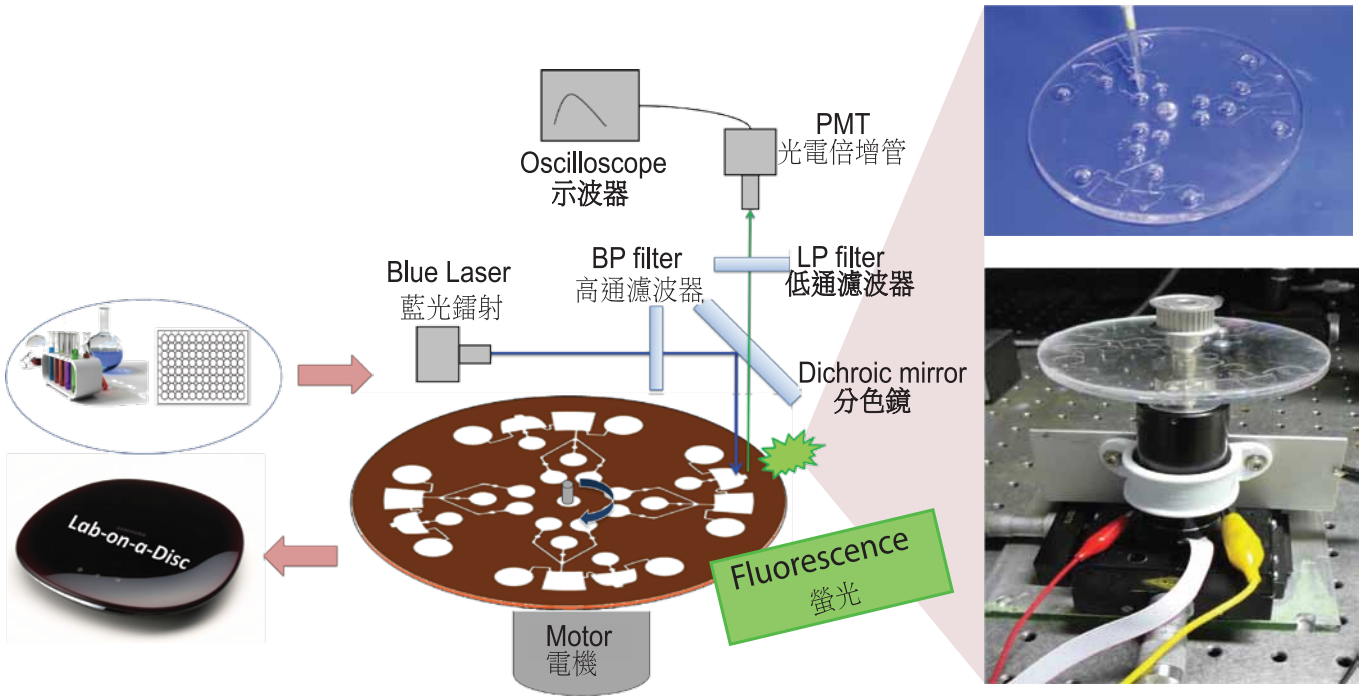
由研究生助學金資助
Funded by Postgraduate research studentship

Collaboration with Programme of Biochemistry, School of Life Sciences; School of Biomedical Sciences; Department of Chemical Pathology, The Chinese University of Hong Kong
合作夥伴為香港中文大學生命科學學院生物化學部、生物醫學學院、化學病理學系



Traditional bioassay is to measure the effects of a biologically active substance in vivo or in vitro using an intermediate in tissue or cell model under controlled conditions. Bioassays have long been widely used in a variety of applications, like testing of medical diagnostics and food safety etc. Usually, it requires tedious fluid handling techniques prone to inducing artifacts and expensive facilities. This project aims to develop centrifugal microfluidic platforms targeting true sample-to-answer compact devices. Centrifugal microfluidics, or "lab-on-a-disk" (LOAD) is a lab-on-a-chip derivative. It integrates a number of microfluidic function components for liquid operations in a compact disk and controls the assay process through simple rotation. Advantages include, simplified procedures, reducing the assay time and sample/reagent consumption, compactness with easy operation, thus enabling industries to explore the huge business potential in both scientific and point-of-care applications.

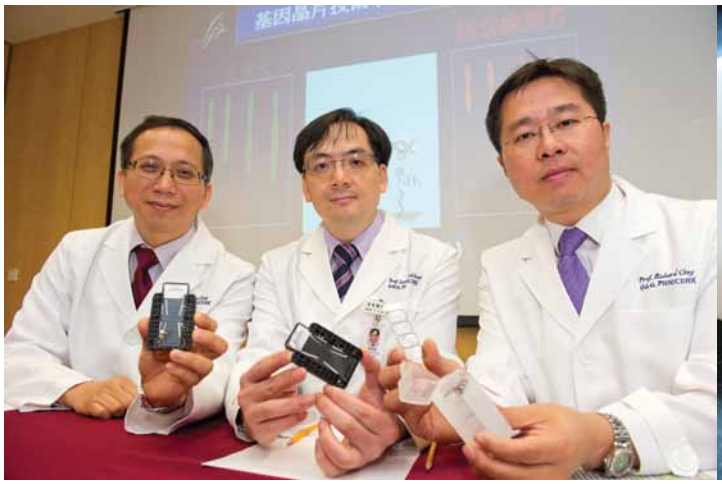
傳統的生物測定分析方法，是通過組織或細胞模型的介質在體內或體外測定生物活性物質，已廣泛應用於醫療、食品等測試，通常需要訓練有素的專業人員、複雜的操作和昂貴的儀器，且極易因為被外來物質污染而導致錯誤結果。此項目旨在開發以採樣-反饋為目標的微型集成離心微流生物測定平台，離心微流或「碟片實驗室」（LOAD）是芯片實驗室的一種，將各種微流控單元整合在一個碟片上，通過簡單碟片的旋轉控制各個檢測步驟。優點包括：試驗步驟簡單、 操作簡易、 減少分析時間和樣品消耗、消除污染、 微型化及高度並行化等， 有助業界探索開發應用於科研和重點照護檢驗（床邊檢驗）產品的巨大商業潛力。

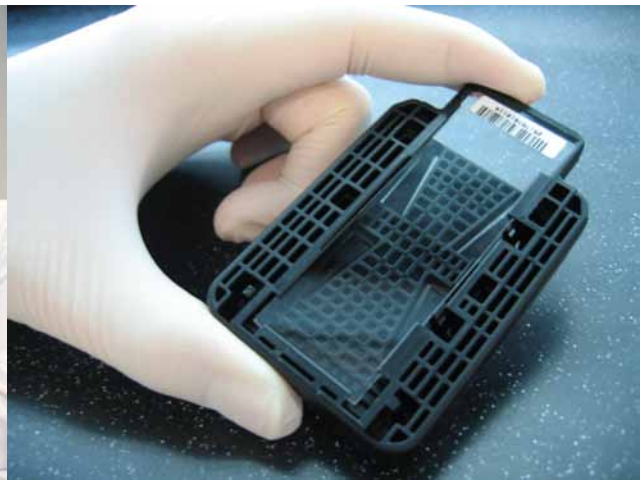
Website 網址 : http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=264

DNA Chip for Prenatal Diagnosis
引入基因晶(芯)片技術作胎兒產前診斷

Prof. LEUNG Tak Yeung
Prof. CHOY Kwong Wai Richard
Department of Obstetrics and Gynaecology

婦產科學系
梁德楊教授
蔡光偉教授





(From left) Prof. LAU Tze Kin, Clinical Professor (honorary); Prof. LEUNG Tak Yeung, Professor and Prof. CHOY Kwong Wai Richard, Associate Professor, Department of Obstetrics and Gynaecology, CUHK, show the DNA chip.
(左起) 中大婦產科學系名譽臨床教授劉子建教授、中大婦產科學系梁德楊教授及蔡光偉教授展示基因晶片

The Department of Obstetrics and Gynaecology at CUHK is the ever-first to introduce the DNA chip in prenatal diagnosis in Hong Kong and the Asia Pacific region. It is a specially designed diagnostic chip with a high resolution to detect common micro-duplication and micro-deletion syndromes, which would not be detected by conventional karyotyping analysis. Fetal DNA chip can give more comprehensive, higher resolution and eariler results. Conventional method detect abnormal genome under a microscope,which is limited by its resolution. The DNA chip is able to diagnose more than 100 recognized genetic syndromes prenatally. It compares the patient's genome against a reference genome (normal control or standard) and identifies differences between the two genomes and hence locates regions of genomic imbalance in the patient. The Department of Obstetrics and Gynaecology, CUHK currently provides this service.

香港中文大學婦產科學系率先在香港及亞太地區引入基因晶(芯)片技術作為產前診斷。利用高解像晶片作檢測，此晶片比傳統染色體核型分析更廣泛、更細緻及更早期檢測因序列重複或缺失而引起之遺傳性疾病，因為傳統方法只限於顯微鏡下發現到的染色體異常，較細微的就無法診斷，晶片可額外檢測超過一百種已知嚴重的基因疾病。這種技術比較病人和對照物的全基因組，以對照物去分辨出病人基因上的拷貝數變異，能為產前風險評估提供更多訊息作為參考，大大減低孕婦的憂慮。目前香港中文大學婦產科學系提供此項檢查服務。

Website 網址 : http://www.fetalmedicine.hk/en/Fetal_DNA_chip.asp
http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=250

A Novel Approach for the Non-Invasive Prenatal Diagnosis of Sex-Linked Disorders

伴性遺傳疾病的無創傷性產前檢測法

Prof. TSUI Bo Yin Nancy
Prof. LO Yuk Ming Dennis
Prof. CHIU Wai Kwan Rossa
Department of Chemical Pathology

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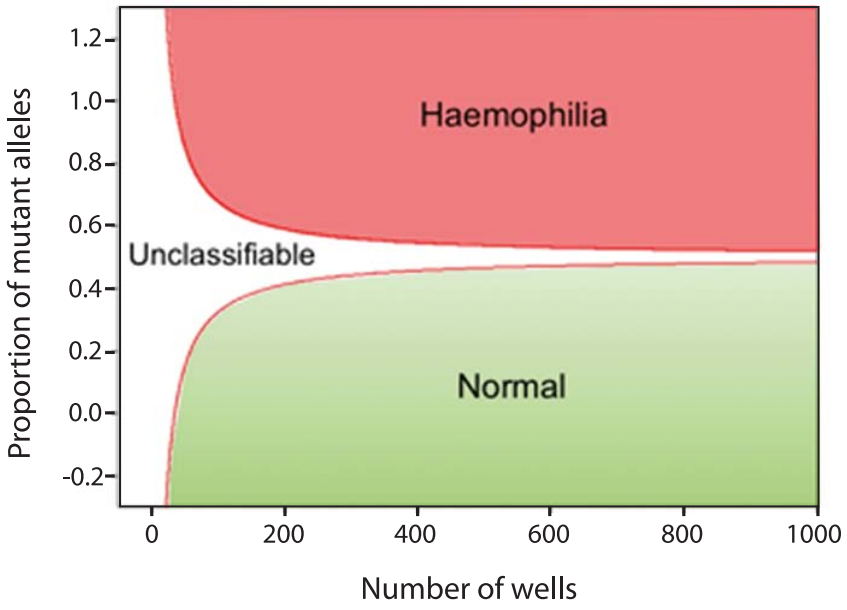
趙慧君教授

Funded by Innovation and Technology Commission
由創新科技署資助

Collaboration with Royal Free Hospital, London, UK
合作夥伴為英國Royal Free Hospital



Digital RMD for non-invasive detection of X-linked diseases in maternal plasma.
利用數碼化突變相對比較技術(Digital RMD)作伴性遺傳疾病的非侵入性產前診斷

Current prenatal diagnosis relies on invasive procedures such as amniocentesis and chorionic villus sampling with risks of fetal miscarriage. Many pregnant women from families at risk for haemophilia decline invasive testing due to the associated risks. The research team has developed a non-invasive prenatal diagnostic strategy to directly analyse X-linked disease mutations carried by fetuses. This development would make prenatal testing less traumatic and safer to at-risk families. We correctly detected fetal genotypes for hemophilia mutations in all of the 12 studied maternal plasma samples obtained from at-risk pregnancies from as early as the 11th week of gestation. The technology developed can also be applied to the non-invasive prenatal diagnosis of other sex-linked disorders.

現行的侵入性產前診斷方法，如抽羊胎水及絨毛膜活檢，有機會導致胎兒流產。許多來自血友病高危家庭的孕婦因侵入性檢測帶來的風險而拒絕接受產前診斷。研究團隊發現懷孕母親的血漿裡帶有游離胎兒DNA，醫生只需抽取母親的血液便可以安全地檢測胎兒，直接並準確分析胎兒的血友病X染色體的等位基因，使高危孕婦得以接受更安全的產前診斷，我們在全部12個高危妊娠的母體血漿樣本中正確檢測出胎兒的血友病基因突變，樣本中最早的妊娠期為11週。這種新方法也可以用於診斷其他伴性遺傳病。

Award : The project result has been published in the scientific journal, "*Blood*".
The Ulla Hedner Haemostasis Award 2011 has been received from the *Access to Insight*.
獎項 ：研究結果已刊登於學術期刊 "血液"，並獲 *Access to Insight* 授予 Ulla Hedner Haemostasis 獎項

Website 網址 : http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=252

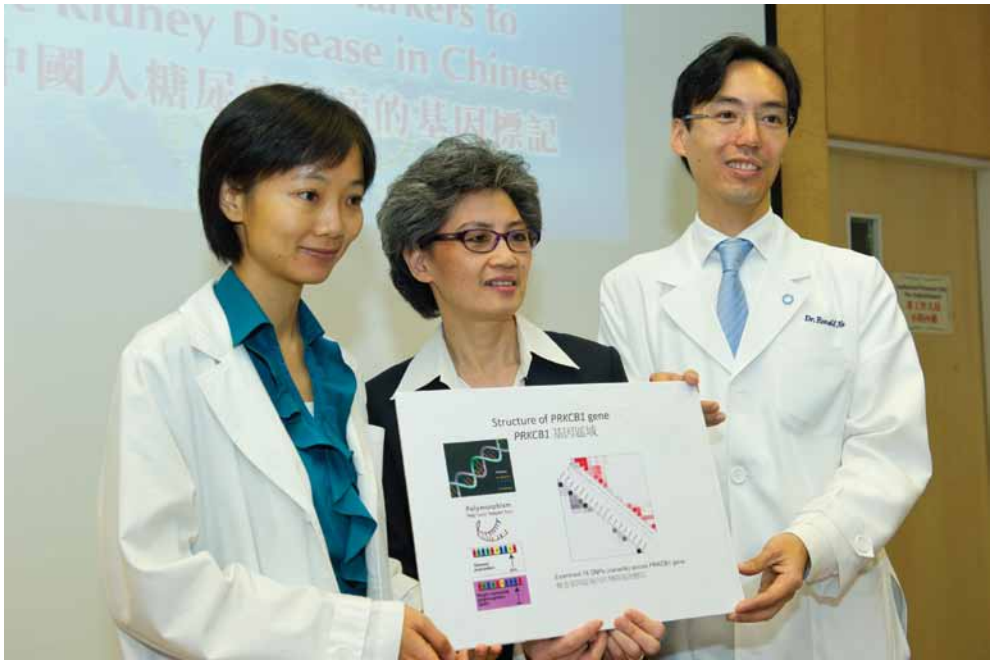
Identification of Novel Genetic Markers of Diabetic Kidney Disease through Genome-Wide Association Study

利用全基因組相關性研究鑒定糖尿病腎病的新遺傳標記

Prof. MA Ching Wan Ronald
Department of Medicine and Therapeutics

內科及藥物治療系
馬青雲教授

Funded by Innovation and Technology Commission
由創新科技署資助



CUHK research group from Department of Medicine and Therapeutics discovered genetic markers to predict diabetic kidney disease in Chinese (from left) Dr SO Wing Yee, Clinical Assistant Professor (honorary); Professor CHAN Chung Ngor Juliana , Professor of Medicine and Therapeutics; and Professor MA Ching Wan Ronald , Associate Professor

香港中文大學醫學院內科及藥物治療學系科研團隊發現預測中國人糖尿病腎病的基因標記（左起）名譽臨床助理教授蘇詠儀醫生、內科及藥物治療學講座教授陳重娥教授、馬青雲副教授

Diabetes is the leading cause of end stage renal failure in Hong Kong. Genetic factors play a key role in the development of kidney disease, which affects 40-60% of diabetic patients. Our group has successfully utilized candidate-gene approach and identified several genetic factors that can predict development of diabetic kidney complications. Genome-wide association is a powerful technology to identify novel genetic markers associated with common diseases, and has recently led to break-through discoveries of genetic markers for type 2 diabetes, cardiovascular disease, rheumatoid arthritis and cancer, as well as several other common conditions. We utilized this new technology to identify novel genetic markers for diabetic kidney disease. The novel genetic markers identified will advance our knowledge of this complex disease and allow the identification of high risk subjects for early prevention and intervention.

在香港，糖尿病是導致腎衰竭的主要原因，約四至六成糖尿病人會發展為腎病，而遺傳因素是其中一個重要因素。我們的研究團隊成功地利用候選基因的方法，確定了一些遺傳因素，可以預測糖尿病腎臟併發症。全基因組相關性研究為常見疾病尋找新遺傳標記提供了創新的技術，近年在二型糖尿病、心血管疾病、風濕性關節炎、癌症以及其它幾種常見疾病都有遺傳標記的突破性發現。本項目旨在利用此項新技術鑒定糖尿病腎病的新遺傳標記，這將進一步加深我們對此複雜性疾病的認識，更重要的是可用以篩選高危人群，以便及早介入和預防。

Website 網址 : http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=265

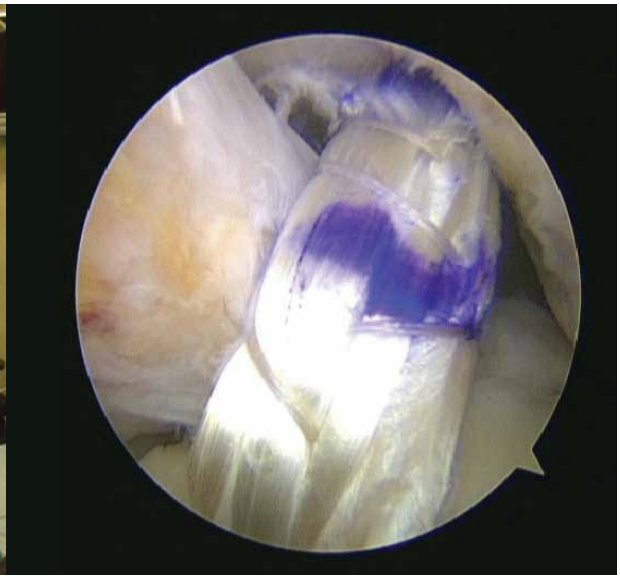
Development of a Vitamin C Surgical Irrigation Solution to Improve Healing Outcomes of Surgical Repair of Tendon and Ligament Injuries

開發維生素 C 沖洗液以促進肌腱及韌帶損傷的術後癒合

Prof. CHAN Kai Ming
Department of Orthopaedics and Traumatology
矯形外科及創傷學系
陳啓明教授

Funded by Innovation and Technology Commission
由創新科技署資助

Overview of the operation theatre conducting arthroscopic anterior cruciate ligament (ACL) reconstruction.
手術室內正進行關節鏡下前交叉韌帶重建手術。



ACL graft in the knee joint, as observed under arthroscope during ACL reconstruction.This is the site where our product will be applied.
在前交叉韌帶重建手術中，利用關節鏡可以觀察到關節內前交叉韌帶移殖物的狀態。本手術沖洗液適用於膝內患處。

Tendon and ligament injuries are very common sporting and occupational injuries. Surgical repair provides a mechanically stable micro-environment for the tendons or ligaments to heal, but the healing outcomes are always compromised by the low innate healing capacity. Conventional surgical irrigation solution only acts as neutral fluid to cleanse the surgical sites. Limited modifications of surgical irrigation solution have been proposed to reduce infection or bleeding, but there is no investigation to develop irrigation solution with an added value to improve healing outcomes. We propose to develop a new formula of vitamin C supplemented surgical irrigation solution which can promote tendon and ligament healing. Advantages of this treatment include: readily compatible to any current treatment practices. It is carried out during surgery and is non-traumatic.The irrigation solution is directly and locally applied to wound, chemically stable. Additionally, vitamin C has a high safety profile.

肌腱及韌帶損傷是十分常見的運動創傷和職業性勞損。手術修復雖然為肌腱及韌帶損傷提供了穩定的癒合微環境，但癒合成效往往受制於自身癒合能力不足。一般沖洗液僅為沖洗創口的中性液體；一些經改良的沖洗液配方能減少流血或感染風險，但是能夠促進癒合的沖洗液則屬創新意念。有見及此，我們建議研發一種嶄新的維生素C沖洗液以促進肌腱及韌帶損傷的術後癒合，好處包括：可跟任何治療方法相容，只需於手術中同時使用，不具創傷性。本沖洗液可直接而局部地應用於傷患處、具有高化學穩定性，而且維生素C對人體安全度很高。

Website 網址 : http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=247

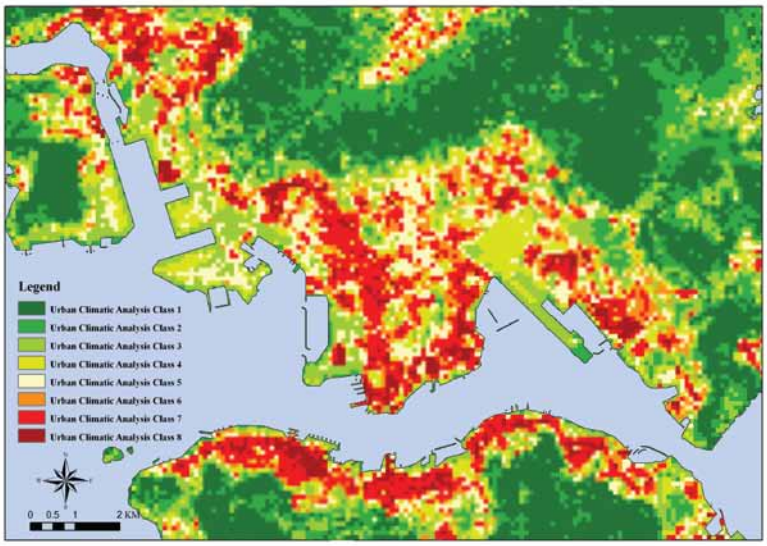
環境和綠色科技
Environmental & Green Technologies

Applying Urban Climatic Information in Urban Planning of High Density City — A Pilot Study in Hong Kong
環境氣候信息在高密度城市規劃中的應用 — 香港地區探索性研究

Prof. NG Yan Yung Edward
School of Architecture
建築學院
吳恩融教授

Funded by Planning Department, Hong Kong SAR
由香港特別行政區政府規劃署資助

Collaboration with Building Department, National Institute for Land and Infrastructure Management, Japan; Hong Kong Observatory; Hong Kong University of Science and Technology; The Hong Kong Polytechnic University; Kassel University, Germany
合作夥伴包括日本國土技術政策綜合研究所建築研究部、香港天文台、香港科技大學、香港理工大學、德國卡塞爾大學



Source: Planning Department, HKSAR

The Urban Climatic Analysis Map of Hong Kong
香港都市環境氣候分析圖

Hong Kong is a high-density city. The effects of high-rise walled buildings arouse people's concern about the relationships among the building design, building density and air circulation. The objective of this project is to apply urban climatic information in high-density urban planning. The research takes the approach of "Urban Climatic Map" to synergize climatic and environmental information in urban planning. Geographical information system (GIS) –based database is created to model the urban microclimate and draw urban climatic maps. Extensive field surveys have been conducted and the physiological equivalent temperature (PET) is used as an index to quantify the impact of the microclimate on people's thermal comfort. Part of this research findings have been incorporated by Planning Department into planning regulations and practice guidelines, in a hope to help cities in China cope with the global climate change issues in their future development.

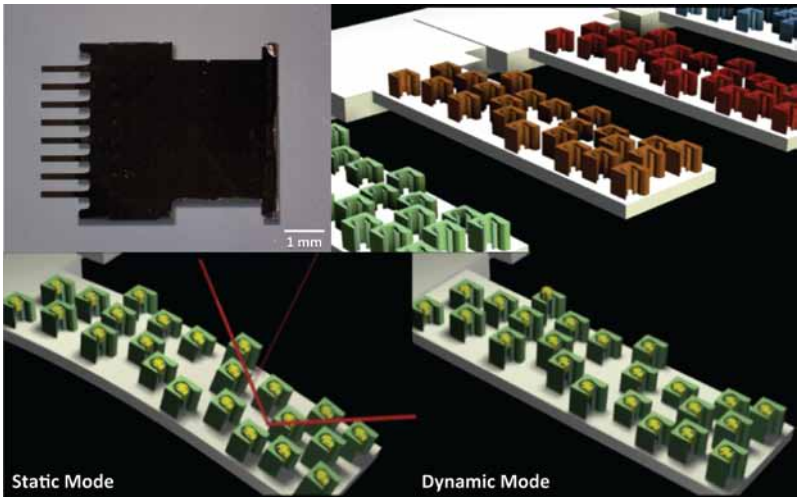
香港是高密度城市，近年出現的屏風樓，令人關注到樓宇設計、密度與空氣流通的關係。本研究項目旨在利用環境氣候信息指導高密度城市規劃。結合氣候、環境和城市規劃等資訊，開展一系列類比和現場試驗，利用地理資訊系統創建資料分析平台，用以繪製都市氣候環境圖，以人體生理等效溫度作為參考指數，用圖像形式解析並展現現存的城市環境與氣候問題。部份研究結果已被香港規劃署採用作為規劃準則和建議，期望此研究結果有助中國未來城市發展積極應對全球氣候變化問題。

Website 網址 : http://www.pland.gov.hk/pland_en/p_study/prog_s/ucmapweb/index.htm
http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=248

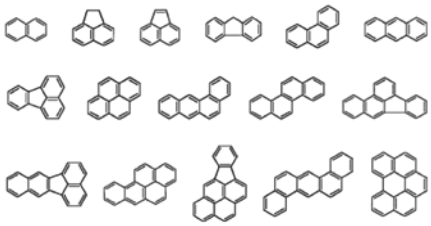
Automated and Continuous Monitoring of Polycyclic Aromatic Hydrocarbon (PAH) in Air Pollutants
自動連續監測空氣污染中的多環芳烴

Prof. YUNG Pun To Douglas
Department of Electronic Engineering
電子工程學系
榮本道教授

Funded by Innovation and Technology Commission and
Shun Hing Institute of Advanced Technology
由創新科技署及信興高等工程研究所資助



An array of microcantilevers coated with different molecular imprinted polymer detects various PAHs in the air. Mass loading on microcantilevers translates into a detectable deflection or broadening in resonance frequency, resulting in two operation modes: static mode and dynamic mode.
微型懸臂傳感器組合塗上不同分子印跡聚合物，檢測空氣中的多環芳烴。懸臂的重量增加會導致傳感器變位或共振變寬，因此有兩種操作模式：靜態模式和動態模式。



Sixteen of the common PAHs have been listed as mutagenic and carcinogenic by the International Agency for Research on Cancer.
十六種常見的多環芳烴被國際癌症研究機構列為有突變性和致癌性的物質

Prof.Yung (middle) and his research team
榮本道教授(中)及其研究小組

Polycyclic aromatic hydrocarbons (PAHs) are a ubiquitous family of organic compounds commonly associated with air pollution as a result of incomplete combustion of organic substances. Exhausts from vehicles and electronic waste disposal are two major contributing sources. Sixteen of the common PAHs have been listed as mutagenic and carcinogenic by the International Agency for Research on Cancer. The current Air Pollution Index in Hong Kong only reports on pollutants such as nitrogen dioxide, carbon monoxide and respirable particulates, but with no measurement on PAHs, despite their significant health implications.

PAH is traditionally measured by high-performance liquid chromatography, which is expensive and time-consuming. The research team is developing a molecular imprinted polymer technique to detect airborne PAHs through the use of a microcantilever-based sensor. The goal is to deliver an automatic and field-deployable PAH measurement device to fulfill the increasing demand in environmental monitoring and health assessment in Hong Kong and Mainland China.

多環芳烴（PAHs）是一種含有兩個或更多融合芳香環的有機化合物，常見於空氣污染中，源自有機物質的不完全燃燒。車輛廢氣和電子廢物處理為多環芳烴的兩個主要源頭。國際癌症研究機構把十六種常見的多環芳烴列為突變和致癌物質。香港目前的空氣污染指數只列出空氣中的污染物，如二氧化氮、一氧化碳及可吸入懸浮粒子，但對健康有重大影響的多環芳烴，卻沒有任何測量指數。

傳統以來，多環芳烴多數採用昂貴和費時的高效液相色譜法作為測量。研究團隊使用分子印跡技術和微型懸臂傳感器，設計出一個便攜式自動監測設備，測量空氣中多環芳烴的含量，滿足香港和中國內地對環境監測和健康評估日益增加的需求。

Website 網址：http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=258

Rational Design of Plasmonic Crystals to Increase the Efficiency of Light-Emitting Diodes (LEDs)
利用等離子激元晶體增強發光二極管效能

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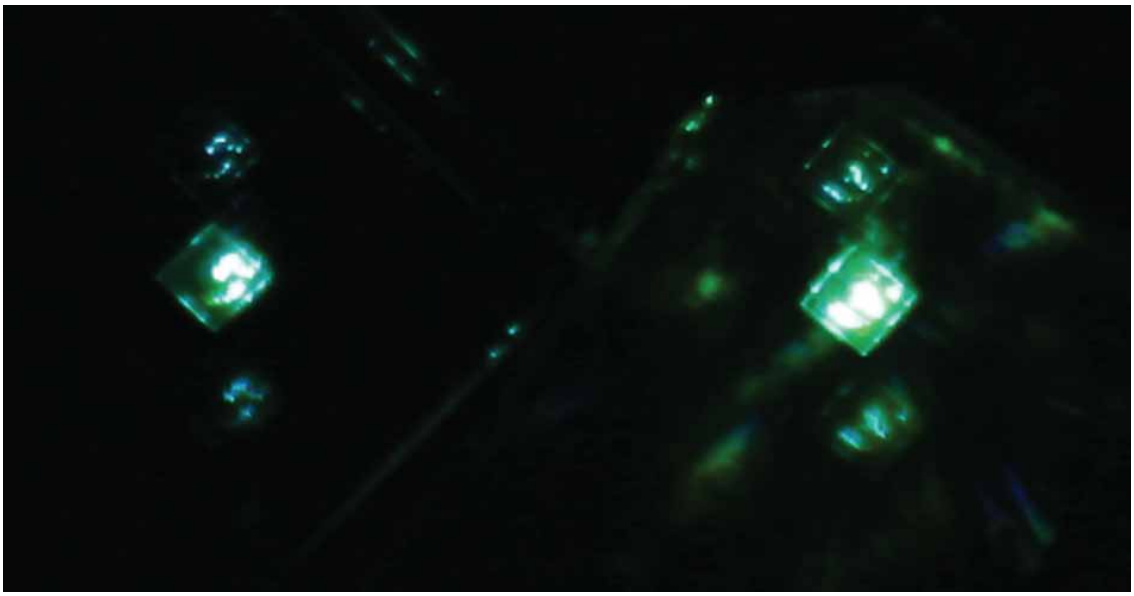
Funded by Innovation and Technology Commisson
由創新科技署資助



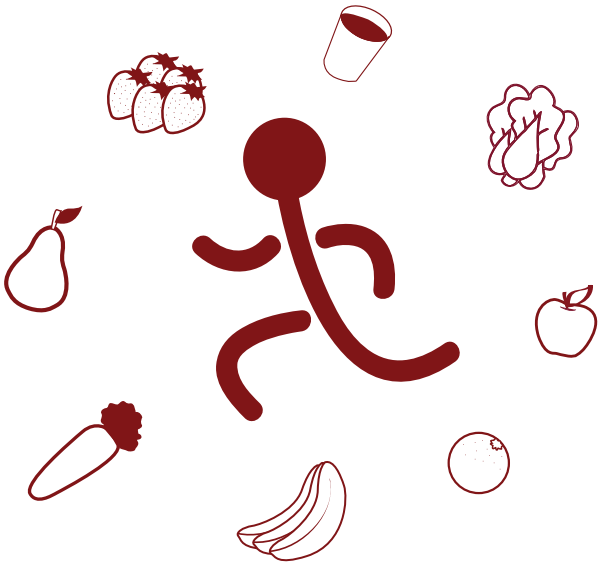
According to our experiment results, the emission efficiency of LED with plasmonic crystals (right) is three times higher than that of untreated one (left).
實驗結果顯示，加上等離子體晶體的發光二極管晶片(右方)，與未經處理的發光二極管晶片(左方)相比，發光效率高出三倍。

Due to the higher refractive index of light-emitting materials, emission from LEDs suffers from high total internal reflection, which lowers light emission efficiency and increases heat dissipation and power loss. By using periodic metallic array, or plasmonic crystal, with appropriate geometry, we are able to channel emission to the electromagnetic resonance modes present on the array rather than being lost in the internal reflection. The emission can then be recovered from the resonance modes, resulting in higher emission efficiency. Our experiment result has shown three times increase of emission from organic LED chip. Since metal invariably is used as electrode for carrier injection, our plasmonic crystals can serve not only as electrode but also as a facilitator to increase light emission efficiency of LEDs in the future.

由於發光材料的折射率較高，故發光二極管存著較高全內反射問題，以致降低發光效率，並增加熱和功率損耗。通過使用週期性金屬陣列，又名等離子漿晶體，我們能夠引導發射光到陣列上的電磁諧振模式中，減低內反射上的耗損。然後，光從共振模式中恢復並且發出，達致更高的發光效率。我們的實驗結果顯示，有機發光二極管晶片，發光效率能增強三倍。由於金屬是用作電極來注入電流，我們的等離子晶體不僅可作為電極，也可以是一個提高發光二極管發光效率的促進機制。

Website 網址：http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=263

食品與健康
Food & Health



Soybean "Homecoming"
大豆回家

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Collaboration with BGI-Shenzhen
合作夥伴為深圳華大基因研究院

Funded by UGC-AoE Plant and Agricultural Biotechnology Center;
Research Grants Council, Hong Kong University Grants Committee;
K.S. Lo Foundation and Lee Hysan Foundation

由教資會卓越學科領域植物及農業生物技術中心、
香港大學教育資助委員會研究資助局、
羅桂祥基金及利希慎基金資助

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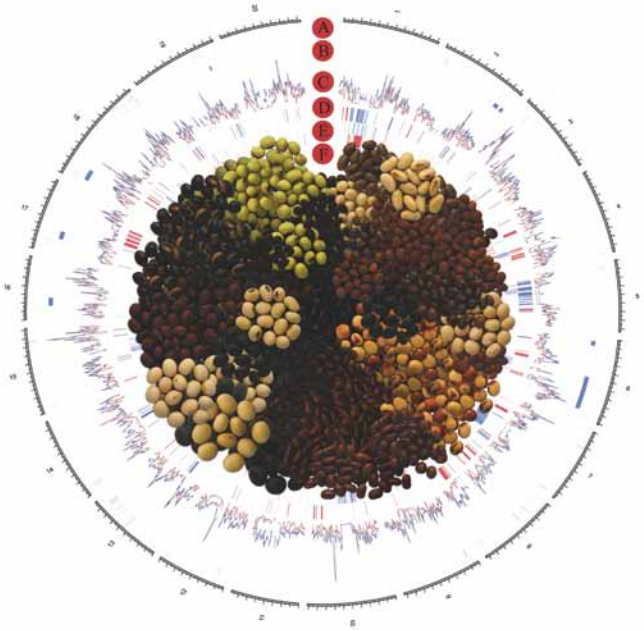
Genomic differences between
wild & cultivated soybean
野生與培植大豆基因組的差異



Soybean is an important cash crop originated in China ~5000 years ago and China has the richest collection of wild soybean germplasms. Soybean provides the most affordable sources of dietary protein and edible oil. It is also an environment friendly crop due to its symbiotic nitrogen fixation capacity. We employed high-throughput genomic sequencing technology to explore novel genes from wild soybeans that may help to increase the adaptation of soybeans to adverse environments. Through this research, the research team verified that wild soybean has a higher genomic diversity than cultivated soybean. They mapped the genomic differences between wild and cultivated soybeans and extracted genomic information to facilitate soybean breeding. The research team disrupted the dominance of industrialized countries in advanced soybean research. Their ultimate goal is to strengthen the sustainable soybean cultivation in her "home", China.

五千年前源自中國的大豆是一種重要的經濟作物，而中國擁有最豐富的野生大豆種質資源。大豆提供廉價的食材蛋白及食用油，同時由於它的共生固氮能力，大豆亦是一種環境友善的作物。研究團隊利用高通量基因組測序的技術，嘗試從野生大豆中發掘能提高對惡劣環境適應性的特有基因。這項研究的成果，包括證明野生大豆的基因組生物多樣性較栽培大豆為高，繪製野生大豆與栽培大豆在基因組內差異的圖譜，以及發掘基因組內的訊息幫助大豆育種。研究團隊突破了先進國家在大豆高端研究的壟斷，最終目的是加強大豆在它的「家」－中國內的可持續種植。

The research finding was published as a cover story in the renowned scientific journal "*Nature Genetics*".
研究結果以封面故事發表在國際著名科學期刊《自然－遺傳》

Website 網址 : http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=246

First-Stage Development of Platform for Authentication of Dried Seafood and Tonic Food Products

鑑定海味及滋補食品平台之初階段開發

Funded by Innovation and Technology Commission
由創新科技署資助

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Collaboration with The Hong Kong Polytechnic University, S.G.S. Hong Kong Limited, Castco Testing Centre Limited, Hing Kee Java Edible Bird's Nest Company Limited, Imperial Bird's Nest International Company Limited, Choi Yue Trading Company
合作夥伴包括香港理工大學、香港通用公證行有限公司、佳力高試驗中心有限公司、樓上燕窩莊有限公司、官燕棧國際有限公司、財裕貿易公司

Dried sea cucumber samples with the same name and category claimed
部份擁有相同名稱及類別的海參樣本

Our study involves some of the high valued dried seafood and bird nest products marketed in Hong Kong
研究計劃涉及在香港暢銷的部份海味及燕窩食品

Because of its duty-free status, Hong Kong has been recognized as the largest regional entrepôt for dried seafood and tonic food products. However, the trade and the relevant authorities have difficulties in verifying the identity and species of these products for authentication, quality control and assurance. This project will develop a platform for DNA-based species authentication of common dried seafood and tonic food products in Hong Kong. The platform will enable the trade to regularly monitor and verify the identity of their products and will also provide the authorities concerned with molecular references for monitoring mislabelling and fraudulent substitution intermittently occurred in the local market. In the long-term, the platform will serve as a major component to set up a comprehensive food safety and quality management system for these food products. The database and platform developed in this project will help the local industry to enhance their reputation by strengthening the confidence of the public and tourists in purchasing the dried seafood and tonic food products of Hong Kong.

因為政府的免税措施，令香港成為區內公認最大的海味及滋補食品集散地。然而，業界或有關當局為這些產品鑑定來源或品種，進行認證、質量控制及保證仍存在困難。這計劃將開發一個可用作DNA品種鑑定香港主要銷售海味及滋補食品之平台。這平台不但可讓業界定期監測及查證其產品之品種，還可向有關當局提供分子參考，從而監控那些於本地市場偶有發生的錯誤標籤，甚至欺騙性替換。 於這計劃所建立的平台及數據庫將會加強市民和遊客購買香港海味及滋補食品之信心，協助本地產業提升商譽。長遠來說，此平台是為這些食品而建立的全面性食品安全與質量管理系統中一個重要部分。

Website 網址 : http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=257

Intelligent Anti-Sprain Sport Shoe
防足踝扭傷智能鞋

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Funded by The Hong Kong Research Institute of Textiles and Apparel (HKRITA) and Innovation and Technology Commission
由香港紡織及成衣研發中心及創新科技署資助

Intelligent anti-sprain shoe is applicable to different sports such as running.
防止足踝扭傷智能鞋可應用於不同種類的運動，例如跑步。

防止足踝扭傷智能鞋的雛形
A prototype of intelligent anti-sprain sport shoe

Ankle sprain is the most common single type of sport-related injury. The research team has successfully developed a prototype of the intelligent anti-sprain sport shoe, which can actively provide protection when needed. The shoe consists of three parts: sensing, identification and correction. It has a sensor to detect the ankle motion in a real time manner. The identification part can determine the sprain risk based on the data collected. If the motion is dangerous, the correction system will be initiated to delay or stop the sprain motion. The corrective system is a myoelectric stimulation device, which can deliver electric signals to the peroneal muscles at the lateral shank to correct the spraining motion. It is a revolutionary innovation of functional sports apparel. It is also the first intelligent anti-sprain application system in the sports area around the world and applicable to different sports.

足踝關節扭傷是最常見的運動創傷，研究團隊成功研發出能主動防止足踝扭傷的智能鞋雛形。該智能鞋由感應、識別和糾正三部分組成，它利用放置在鞋內的感測器檢測足踝活動，如動作有扭傷危險，矯正裝置便會啟動以延遲或停止扭傷動作。矯正裝置利用肌電刺激的原理，把電訊號傳至足踝外腓骨肌以改正扭傷動作。這是一個革命性的創新功能運動裝置，也是全球首個應用於體育界的防扭傷智能系統，適用於不同種類的運動。

Website 網址 : http://www.ort.cuhk.edu.hk/spblab/
http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=256

An Inexpensive Functional Finger Prosthesis with Rebounded Type Progressive Hinge Lock

廉價及功能性的漸進式鉸鎖手指義肢

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黃詠儀醫生　方迪培教授
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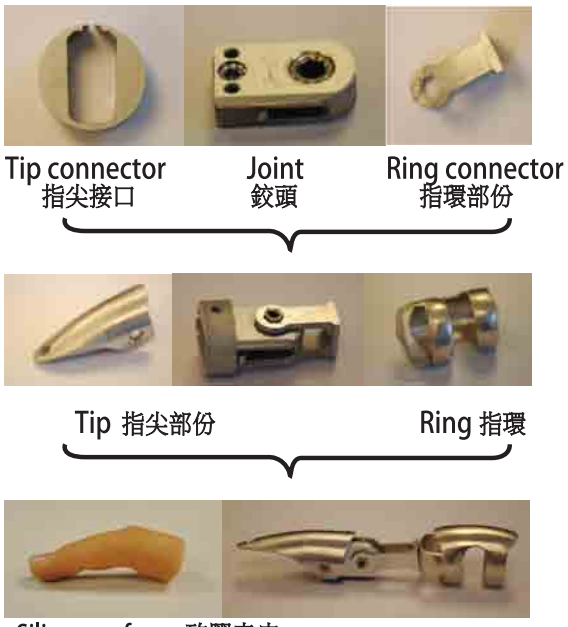
Funded by Shun Hing Institute of Advanced Engineering
由信興高等工程研究所資助

Collaboration with Megain Co. Ltd.
合作夥伴為達億美有限公司

Finger Prosthesis
手指義肢



The current invention is a simple passive device with low cost but would maintain basic hand functions for most daily tasks of patients with lost fingers. A ring-like detachable structure is to be designed to attach the prosthesis to the remaining finger bone with the surrounding muscles and soft tissues. The artificial finger joint is made with a rebounded type progressive hinge lock starting from full extension of the whole finger joint. The hinge lock can be moved in one direction passively (to reproduce finger flexions) and would resist forces to the opposite direction unless the joint is passively unlocked. Such design provides simple passive flexion adjustment and serves as an inexpensive prosthesis for patient having finger amputation to regain basic hand function. The prosthesis restored the opposition function of hand of single or multi-finger amputees. By applying enough prosthesis on the involved hand, it is possible for them to pick up large heavy object.

漸進式鉸鎖手指義肢是一種低成本且設計簡單的產品，但可讓斷指傷者維持日常生活所需的基本手部功能。手指義肢有一個可拆卸的指環，用來連接自有肌肉／軟組織的手指部分。它的人工手指關節是一個分段式鎖鉸，整個手指關節可以充分伸展開。手指義肢可借助外力屈曲到適當的角度，並抗衡伸展的壓力，直至抗衡伸展的鎖鉸被解開。使用此義肢的手指截肢患者，能作出簡單的手指屈曲調整，從而恢復基本的手部功能，若他們使用足夠的義肢，甚至有可能提起大型重物。

Website 網址 : http://www.ort.cuhk.edu.hk/spblab/
http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=255

信息和通訊科技
Information & Communication Technologies

Bacterial Based Storage and Encryption Device
細菌加密硬盤

Instructors – YU Chi Shing, LI Jing Woei and YIM Kay Yuen Aldrin
Students – LOO Fong Chuen Jacky, CHOI Ricky Thomson, CHU Tin Yi,
WONG Kit Ying, CHIU Wai Yin Vivien,MAK Ka Yan Cathy,
LIU Si Si Sophie and WONG In Chun Ada

Prof. CHAN King Ming
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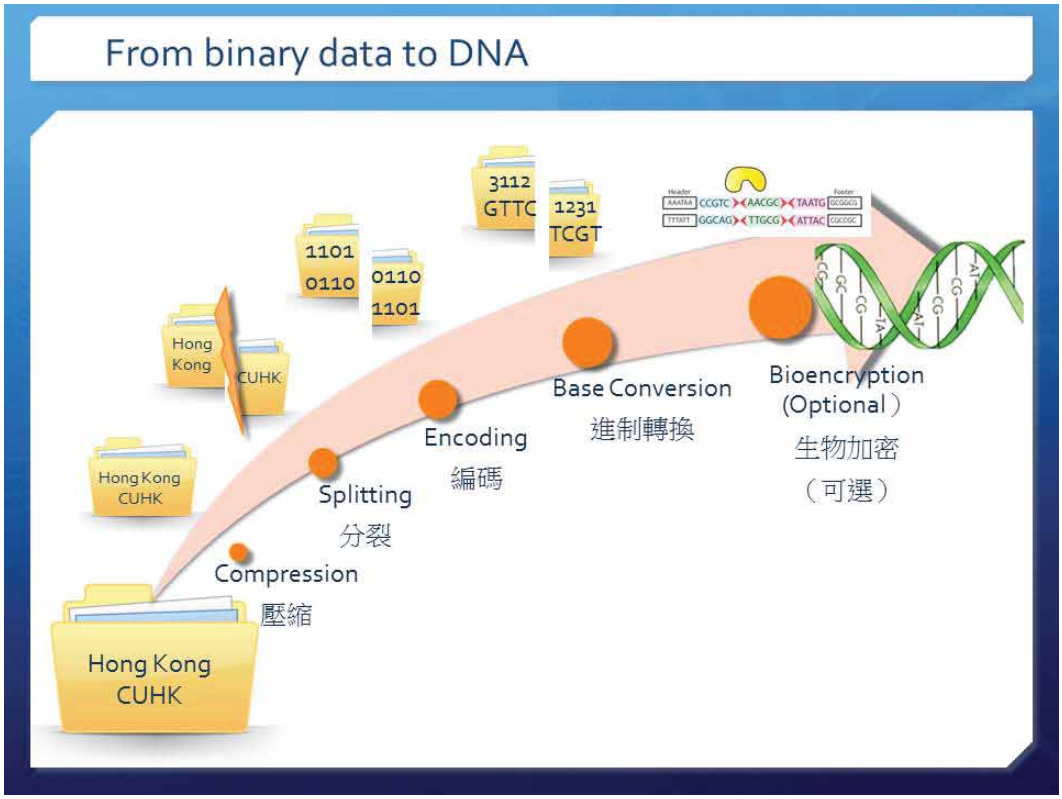
趙贊然、麥嘉欣、劉思斯及黃妍珍　江紹佳教授



Using bacteria as an information storage device was proposed about a decade ago. However, a CUHK team was the first to use the plasmid DNA of Escherichia coli to encrypt and store information not only in the form of text, but also in the forms of images, biological barcodes, etc. In order to store a massive amount of data, the team proposed to fragment the information and store them in bacteria. A novel information processing system was invented to reconstruct the original information. With this technology, it is estimated that one gram of bacteria can store data of up to 900,000 GB (gigabytes), which is equivalent to 450 hard drives, each with 2 TB (terabytes) of storage capacity. The biocryptography system has a great potential for long term and large scale data storage, and is also applicable to the production of genetically modified food and organisms.

大約十年前，有科學家提出利用細菌儲存資料，並發現不同細菌在儲存資料上有不同優勢。一組中大學生率先利用大腸桿菌的質粒基因來儲存資料，包括文字、圖片及生物標記條碼等。他們提出將龐大資料數據分成小份，再運用特設的嶄新系統為各個小份排序，以確保在存入資料以至提取重建的過程中，保持訊息完好無缺。透過此技術，一克細菌可儲存多達90萬GB（gigabytes）數據，相等於450個現有最大容量的2TB（terabytes）硬碟。嶄新的生物加密系統亦具廣泛的應用前景，如製造基因改造食物及生物條碼。

Award: The student research team won gold at the International Genetically Engineered Machine (iGEM) 2010 competition organized by the Massachusetts Institute of Technology (MIT) in the US.
獎項：研發此技術的學生於美國麻省理工學院舉辦的2010年度國際基因機器設計大賽（iGEM）勇奪金獎。

Website 網址：http://2010.igem.org/Team:Hong_Kong-CUHK
http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=266

FADE: Secure Overlay Cloud Storage with File Assured Deletion

確保有效刪除數據的雲端儲存安全附加系統

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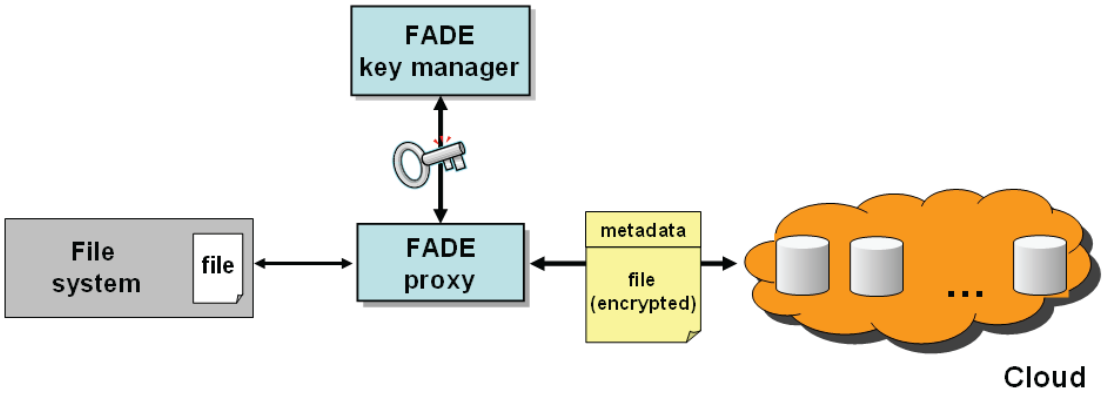
計算機科學與工程學系
李柏晴教授

Funded by Shun Hing Institute of Advanced Engineering
由信興高等工程研究所資助



FADE: Achieving Assured Deletion for Cloud Storage

To reduce the financial overhead of data storage, enterprises and government agencies can now outsource data storage management to third-party cloud storage services (e.g., Amazon S3), which provide abundant storage resources for hosting terabytes of data on an on-demand basis. With the advent of mobile devices, individuals can also be benefited from cloud storage by moving personal data, such as photos or videos to the cloud.

We design and implement a secure overlay cloud storage system called FADE, a practical cloud storage system that protects outsourced data with the guarantees of assured deletion. FADE seeks to be compatible with today's cloud storage infrastructures, in order to create a new value-added security service to the emerging cloud storage technology.

Our main idea is to decouple the management of encryption keys and outsourced data, such that the encrypted data is stored on the cloud provider, while a smaller size of encryption keys are fully controlled by the data owner. To achieve assured deletion, we delete keys of an encrypted file and make the encrypted file copy unrecoverable.

為了減少數據儲存方面的開支，企業和政府機構可以把數據儲存管理外判到第三方的雲端儲存服務(例如 Amazon S3)，外判提供的充裕空間可按實際需要來儲存數以萬億字節的數據。隨著流動電腦及通訊器材的普及，個人用戶亦可利用雲端儲存服務，把個人數據(如相片或影音)搬到雲端上。

我們設計和實踐一個實用的雲端儲存數據安全附加系統以保護外判數據，並提供保證刪除的安全特性。它亦同時可適用於今天的雲端儲存架構，為新興的雲端儲存技術製造一種新的增值安全服務。

我們的主要構思是分開的加密密鑰和外包數據的管理，加密數據儲存在雲端儲存供應商，而加密密鑰由數據的擁有者完全控制。如要達致確保刪除，我們只需刪除對應加密文件的密鑰，令加密文件不能還原。

Website 網址 : http://ansrlab.cse.cuhk.edu.hk/software/fade
http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=242

LiveDFS: A Live Deduplication File System
免重複檔案儲存系統

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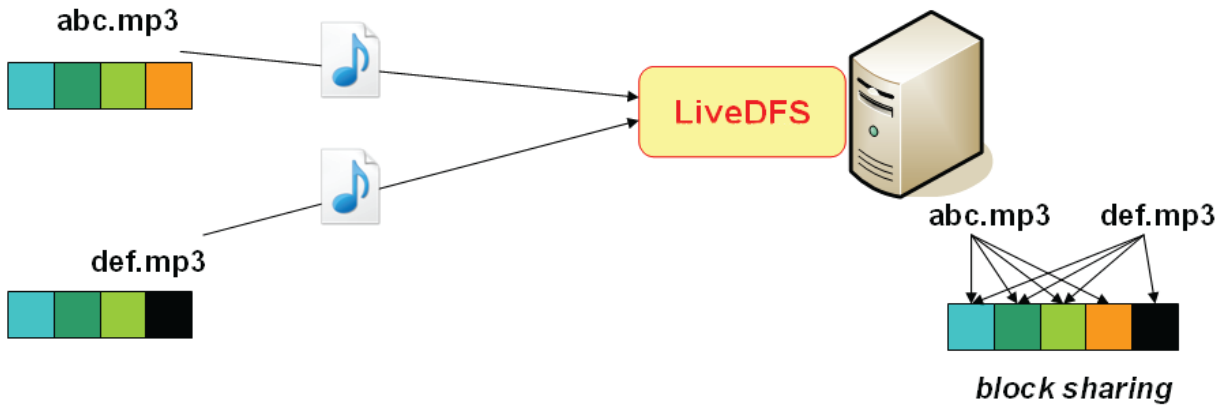
Prof. LUI Chi Shing John
Department of Computer Science and Engineering

計算機科學與工程學系
李柏晴教授
呂自成教授

Funded by Innovation and Technology Commission
由創新科技署資助



LiveDFS: Improving storage efficiency via deduplication

Deduplication is an emerging technique recently adopted in data centres. Such technology exploits and removes data redundancy stored on the physical media. With the redundancy removed, the storage space will be saved. Typically, a 10- to-1 saving ratio can be achieved in archiving storage servers. Through LiveDFS developed by CUHK, middle-class and low-end storage manufacturers can assemble their own deduplication-enabled storage servers. SMEs can be benefited by reducing the number of servers deployed. In long-term, with the widespread of the deduplication-enabled servers, we can protect our environment by cutting down the total energy consumed by servers.

LiveDFS implements a block-level data deduplication strategy. Our approach is to exploit the redundancy of the data blocks. While the system is saving a file, if there exists an identical data block on the disk, LiveDFS will then share the found data block instead of creating a new data block. For example, when File A is copied to File B, the content of File A will be shared with the content of File B. This can reduce the space consumed by half, comparing to traditional file systems.

免重複儲存技術是一項新興的、普及於數據中心的技術。此技術能消除硬碟上的重複資料，從而節省硬碟的使用空間。在一般情況之下，例如備份服務(伺服)器，免重複儲存技術能節省九成的存儲空間。本項目旨在開發應用在中小型儲存服務器及嵌入系統上的免重複儲存技術。透過使用中大研發的免重複檔案儲存系統，中小型儲存服務器的生產商能節省儲存服務器的投資，長遠來說，更可以節能環保。

免重複檔案儲存系統實現了重複數據塊刪除策略。當系統保存一個文件，如果存在相同的數據塊在磁盤上，系統會讓文件分享現存的數據塊，而不創建一個新的數據塊。例如，當一個文件A被複製到另一個文件B，文件A和文件B將共享一個文件的內容。這樣相對於傳統的文件系統可以減少空間消耗的一半。

Website 網址 : http://ansrlab.cse.cuhk.edu.hk/software/livedfs
http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=243

NCFS: Network-Coding-Based Distributed File System
基於網絡編碼的分佈式儲存系統

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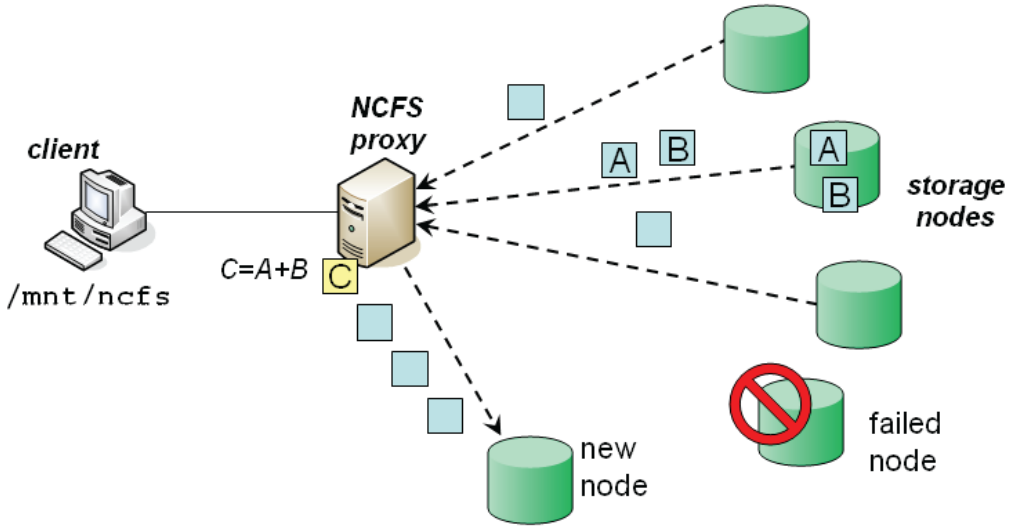
由網絡編碼研究所卓越學科領域計劃資助
Funded by Areas of Excellence (AoE), Institute of Network Coding



NCFS: Achieving fast data repair using network coding

Distributed storage systems store massive amounts of data over a set of storage nodes that are distributed over a network. One key feature of distributed storage is data reliability based on the redundancy of data storage. Specifically, given the pre-determined level of redundancy, the distributed storage system must sustain normal I/O operations within a tolerable number of node failures. In addition, in order to maintain the required redundancy, the storage system must support data repair. A critical issue is how to achieve timely repair process, so as to minimize the chance of data unreliability when more nodes are failed.

NCFS is designed as a proxy-based distributed file system that interconnects multiple storage nodes. It uses network coding-based storage schemes to allocate data blocks in different storage nodes. We enhance the file system to support the data repair operation using network coding. That is, if a node is failed, then the repair operation will (i) read data blocks from survival nodes, (ii) regenerate lost data blocks, and (iii) write the regenerated blocks to a new node. Existing theoretical studies and our experiments show that network-coding-based storage schemes minimize the repair time compared to traditional RAID-like storage schemes.

分佈式儲存系統，能在分佈於網絡上的不同節點中，儲存大量數據。它的一個重要特點，是利用數據的重複性以達到儲存的可靠性。具體來說，按照預定的重複水平，分佈式的儲存系統可以承受一定數目以下的節點故障而同時保持正常的讀寫操作。為了維持所要求的重複水平，儲存系統必須支持數據修復。一個重要的問題是如何達致及時的修復過程，從而減少因為更多節點故障而造成數據失效的情形。

這個分佈式文件系統建基於代理模式的設計，它能互連多個儲存節點，使用以網絡編碼的方法分配數據塊在不同的儲存節點上。我們在文件系統設計上加上了使用網絡編碼的數據修復功能。簡單來說，如果一個節點失效，那麼修復操作將為： (i) 從現有的節點上讀取數據塊，(ii) 重建丟失的數據塊，(iii) 把再建的數據塊寫入到一個新的節點。現有的理論分析和我們的實驗均證明，以網絡編碼為基礎的儲存方法能夠比傳統的RAID儲存方法減少數據修復時間。

Website 網址 : http://ansrlab.cse.cuhk.edu.hk/software/ncfs
http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=244

Traffic Accelerator for Mobile Data Networks
移動數據網絡加速器

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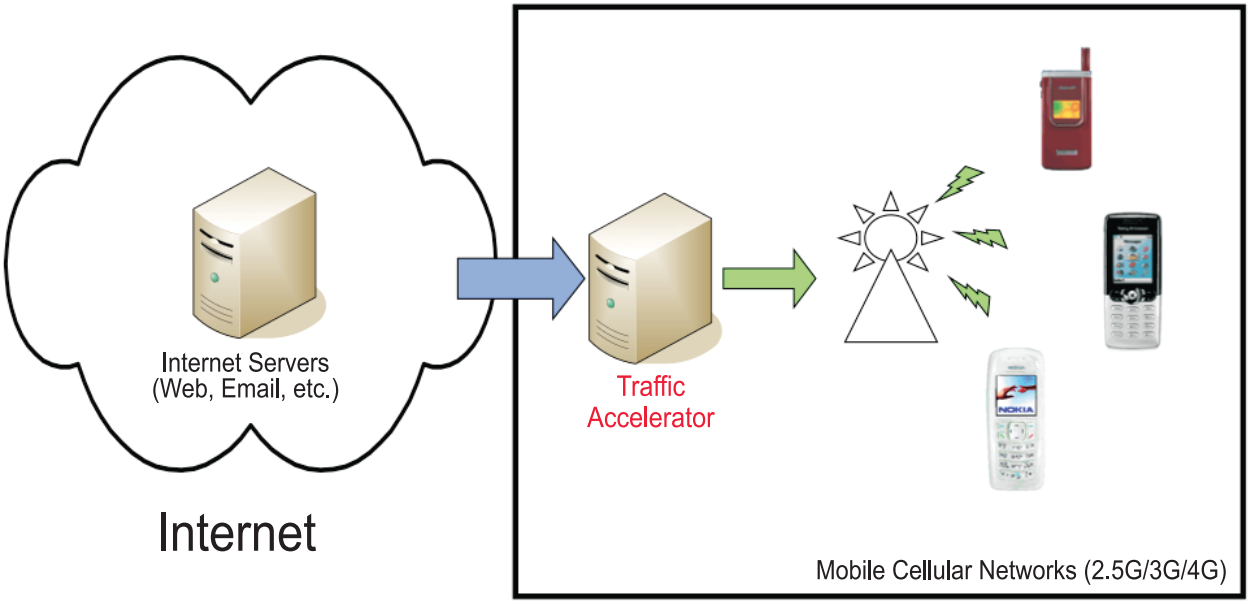
Funded by Innovation and Technology Commission
由創新科技署資助



3G user populations have grown rapidly in recent years and soon more users will be connected via mobile data networks than wired networks. Nevertheless the key Internet transport protocol - Transmission Control Protocol (TCP), is still rooted in wired networks, and its performance is hitting a serious bottleneck in mobile networks - our experiments revealed that TCP can achieve merely one-third of the bandwidth available in today's 3G networks.

This project develops a novel traffic accelerator to resolve TCP's performance bottleneck in mobile data networks. Our preliminary feasibility study showed that the mobile accelerator can increase the achievable throughput of existing TCP traffics by over three times, thus enabling mobile operators to instantly raise their network service quality to a new level. No hardware or software change in content provider, handset or client terminal is required. This will also pave the way to the emerging mobile technologies such as LTE and 4G which promises even higher bandwidth, strengthening Hong Kong's leading position as an information hub.

隨着3G用戶數量的高速增長， 將來移動數據網絡用戶數量將會比有線數據網絡用戶更多。 可是現今互聯網傳輸協議Transmission Control Protocol (TCP)的設計，乃是以有線網絡為基礎，令其在移動網絡上之有效速度遠遜預期。據我們的實驗顯示，傳統TCP僅可實現3G網絡可用頻寬的三分之一。這項目旨在開發一嶄新的移動數據加速器，以解決TCP在移動數據網絡上之速度樽頸。經初步可行性研究證實，此加速器可提升現時TCP數據流通的速度達三倍以上，大大提高網絡營運商之服務質素，而內容供應伺服器、手機或終端機的硬件和軟件都不需任何改動，此技術更可應用於新興的移動技術如LTE和4G，提供更高速度的移動數據服務，進一步鞏固香港作為信息樞紐的領先地位。

Website 網址 : http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=239

An Extensible Distributed Measurement Platform for Analyzing Quality-of-Experience (QoE) of Multimedia Applications over Wireless Networks
無線多媒體用戶感知質量（QoE）之分佈式測量

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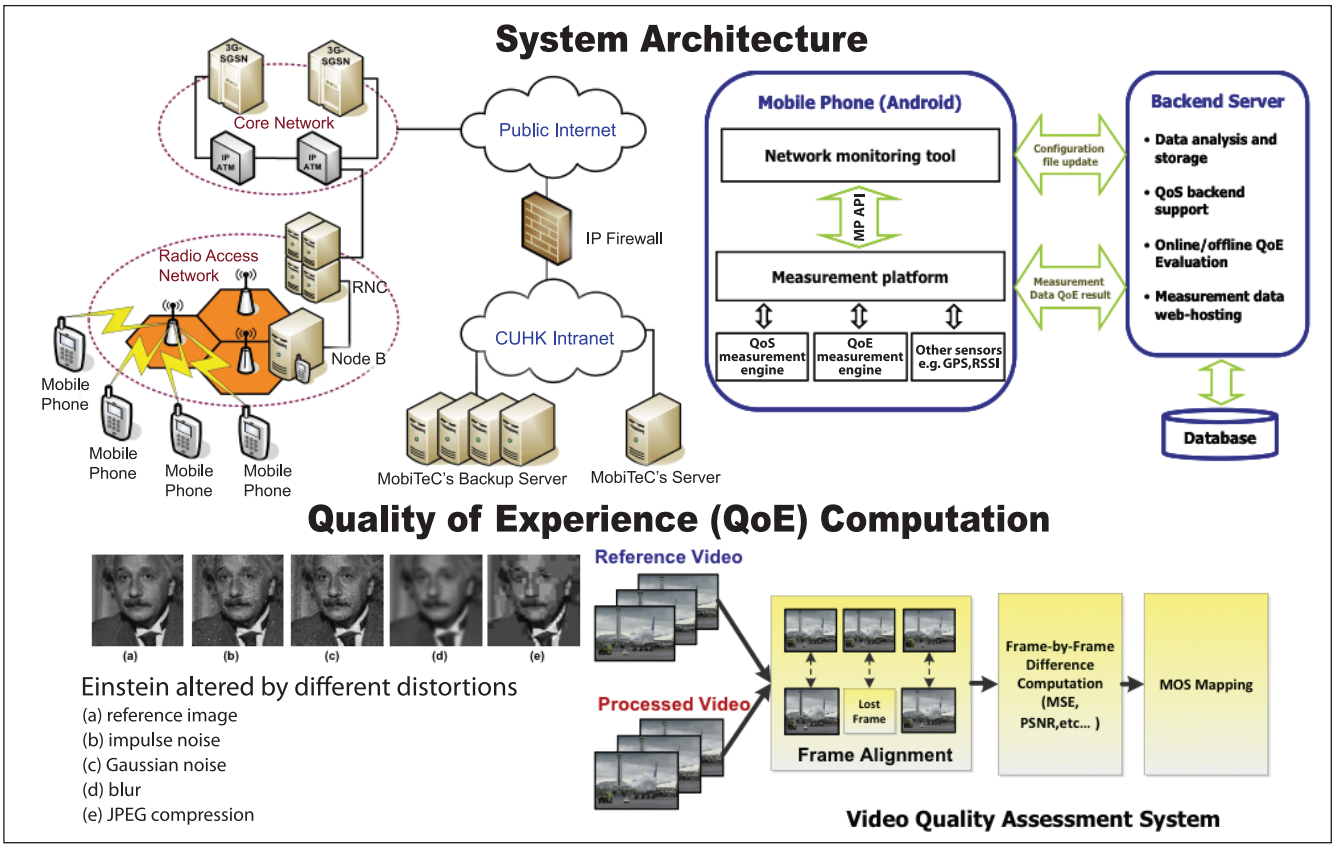
Funded by Innovation and Technology Commission and SmarTone Mobile Communications Limited
由創新及科技署及數碼通電訊集團有限公司資助

Collaboration with SmarTone Mobile Communications Limited
合作夥伴為數碼通電訊集團有限公司



Wireless service providers need to be able to continuously monitor the network Quality-of-Service (QoS) and the Quality-of-Experience (QoE) received by its users. This is so that the providers can collect the necessary feedback to optimize their networks, in order to achieve customer satisfaction while operating cost-effectively. This project proposes to design and develop a configurable, scalable and extensible measurement platform on mobile devices that will allow us to monitor network-level QoS performance metrics, do real-time mining of the collected data and perform real-time estimation of the user-perceived QoE of multimedia streams. Using this distributed platform, we will conduct extensive field measurements on commercial wide-area wireless networks to evaluate the joint effects of wireless network transmission artifacts, heterogeneous mobile devices, multimedia content and codec parameters, on the perceived QoE of multimedia streams. The findings of these measurements will provide critical data and insights for the providers to re-engineer and optimize their wireless networks for different types of emerging multimedia services.

無線網絡服務供應商需要不斷監測網絡服務質量 (QoS)和用戶感知質量 (QoE)，收集必要的信息反饋，並優化網絡，以令客戶滿意又符合成本效益。此項目旨在多種手機系統上設計及開發一個可配置、可擴展的測量平台。我們可以通過此平台在收集網絡層面上的網絡服務質量(QoS)指標，對實時發掘數據作出分析， 並對多媒體應用程式的用戶感知質量(QoE) 進行實時評估。我們會利用這個分佈形式的平台，在商業廣域無線網絡上進行實地測量，以評估網絡傳輸、多媒體內容和編解碼器參數對多媒體串流的聯合影響。這些測量結果將為供應商提供重要的依據，協助他們調整並優化網絡。

Website 網址 : http://mobitec.ie.cuhk.edu.hk/edmp/
http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=267

Core Technology for Multimedia Signal Processing and Productization for Converged 3G Network, Index & Retrieval
面向3G融合網絡的多媒體信息處理核心技術及產業化搜索和索引

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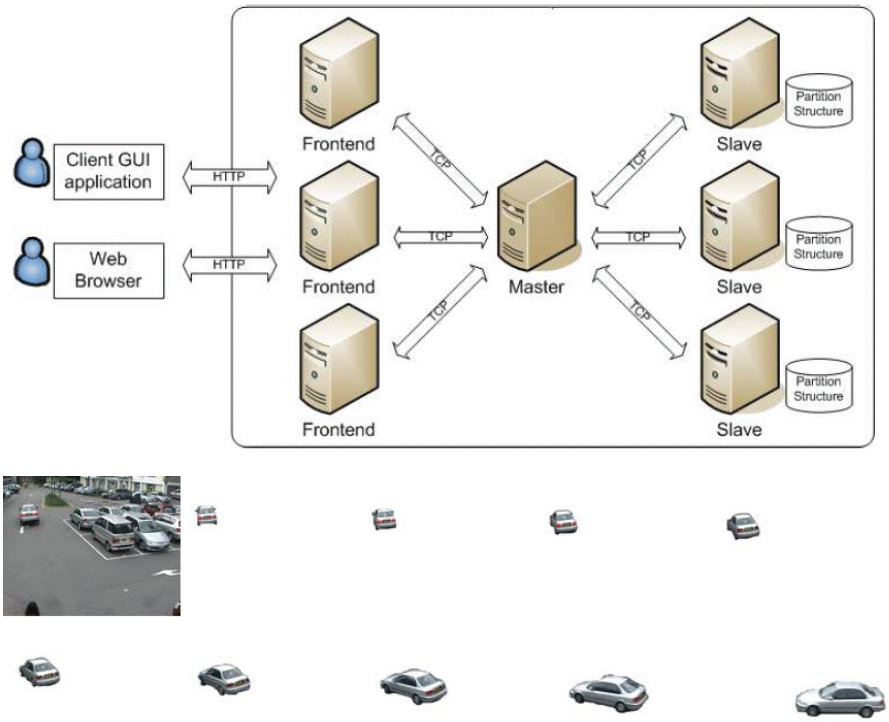
Funded by Innovation and Technology Commission
由創新科技署資助



We propose to develop content-based object image indexing and retrieval technology for surveillance application. It is aimed to help users to search video contents from huge library of surveillance videos.

In a search process, inquiry can be made with sample image, sketch or pre-defined colour or texture samples. Search from a very large multimedia database can be done through interactive inquiry and feedback mechanism.

本項目旨在開發高效率的視覺特徵索引算法，應用於一套實用的監控視頻系統來建構快速的影像索引和檢索功能。這系統可幫助從大量視頻錄影庫中找出有用的影像資料。

在檢索查詢時，可使用樣本查詢，通過輸入樣本圖像，手繪輪廓圖或使用預定義的顏色和紋理樣本等。通過用戶互動反饋機制可以從龐大的多媒體信息庫中找到正確的信息。

Website 網址 : http://www.viewlab.org
http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=271

Intelligent Video Surveillance
智能視頻監控

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Funded by The Chinese University of Hong Kong; Research Grants Council, Hong Kong University Grants Committee
由香港中文大學及香港大學教育資助委員會研究資助局資助

Detection & Identification of Objects - e.g.Face detection in white box. Bill Gates is identified in red box.
物體的檢測與識別，例如白方框表示檢測的人臉，紅色方框表示識別出的身份為比爾蓋茨。

Detection of Abnormal Activities - e.g.Theft of baggage is found.
異常行為的檢測，例如行李盜竊。

Classification of Activities - e.g.Activities are classified into different colours.
物體活動的識別，例如不同顏色表示不同的活動。

Classification of Moving Objects - e.g.Pedestrians are in green. Vehicles are in red.
移動物體的分類，例如綠色表示行人，紅色表示車輛。

Nowadays there are tens of thousands of surveillance cameras in large cities, and they collect a huge amount of video data at every moment. There is an urgent need to develop intelligent video surveillance systems to efficiently extract useful information from video streams. Our system can automatically detect, track and recognize objects of different categories, analyze the activities of objects, and detect abnormal and dangerous activities. It has wide applications in different fields, such as homeland security, anti-terrorism, anti-crime, searching for suspects and lost persons, detection and prediction of accidence, monitoring patients, elderly and children, and traffic management.

現代城市裝有數以萬計的監控攝像頭，每時每刻採集海量的視頻數據。迫切需要藉助計算機從海量視頻數據中快速有效的提取有用信息，以節省人力資源。我們研究的智能視頻監控系統可以從攝像頭網絡中自動從採集的視頻中發現、跟踪和識別各種不同的物體，分析物體的活動，以及發現異常和危險的活動。它在諸多領域中有著廣泛的應用，例如國家安全，防止和發現犯罪行為，尋找疑犯和失踪人員，意外事故的預測和檢測，監控病人、老人和兒童，以及交通控制等等。

Website 網址 : http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=259

EagleEye — The Ultimate Solution for Outdoor Exploratory Learning
「隨行學」— 戶外探索性學習終極方案

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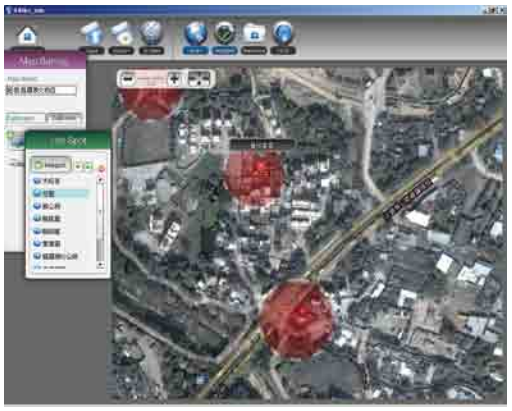
Front-end Platform of EagleEye
「隨行學」前端平台

Outdoor Exploratory Learning with EagleEye
利用「隨行學」進行戶外探索性學習



Back-end Console of EagleEye
「隨行學」後端控制台

EagleEye is the ultimate solution for outdoor exploratory learning in topics such as geography, biology, culture, and sustainable development. The software platform consists of a front-end on a GPS-enabled UMPC or tablet computer, allowing student-centered exploration of an outdoor environment using location-based guidances. Students can access learning materials designed by course teachers in an on-demand fashion. The back-end PC-based console allows teachers to pre-load and tag map images, and attach tailor-made learning materials such as multimedia artwork, guiding notes and learning task deployment. The console also enables teachers to monitor the exploration tracks of the individual student groups and collect student submissions at the end of the learning activity.

「隨行學」為進行相關地理、生物、文化及可持續發展等主題下的戶外探索性學習提供了一個終極方案。同學可利用支援衛星導航系統的超級移動電腦或平板電腦，透過「隨行學」的前端平台取得衛星定位探索指引，以學習者為中心的模式在戶外進行探索性學習。另一方面，「隨行學」的後端控制台能讓老師預置和標籤地圖，以及附加度身訂造的學習材料（如多媒體素材、探索指引和學習任務資料等），好讓同學按需要隨時存取。老師亦可利用該控制台監察個別學習小組的探索行蹤，以及在學習活動完結時收集同學的作業。

Website 網址 : http://caite.fed.cuhk.edu.hk/ee
http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=272

An Internet-Based Platform with Automatic Speech Recognition Technologies to Support Online Computer-Aided Pronunciation Training (CAPT) for Chinese Learners of English

針對中國人學習英語的語音識別技術及訓練發音的網上平台

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蒙美玲教授

Funded by Innovation and Technology Commission; Shun Hing Institute of Advanced Engineering and Teaching Development Grant, The Chinese University of Hong Kong
由創新科技署、信興高等工程研究所及香港中文大學教學發展補助金資助

The CAPT system can pinpoint the erroneous pronunciations of Chinese Learners and diagnose the errors (indicated in red) to generate instructions for improvement.
CAPT系統能針對中國人學習英語時常犯的發音錯誤，診斷出錯處(以紅色顯示)，並提供改善指引。

Prof. MENG (first row middle) and her research team
蒙美玲教授 (前排中)及她的研究小組

As Hong Kong is a dynamic, international metropolis, we are often surrounded by different world events. It is critically important that we acquire communicative competence in English. However, the process of second language (L2) acquisition is interfered by well-established perceptions and productions of sounds in the primary language (L1). We often observe notable L1 (i.e. Chinese) interferences with L2 (i.e. English) speech. The interferences are ingrained with age and hamper acquisition of proficiency. Improvements require persistent and individualized training.Moreover, recent advancements in Internet technologies have opened up new possibilities for an accessible, round-the-clock, self-paced and personalized platform in CAPT. We believe that an Internet-based CAPT platform that can potentially assist a vast number of Chinese learners in achieving communicative competence and overall proficiency in spoken English.This system is being used in The Chinese University of Hong Kong, for classes offered by the English Language Teaching Units, Faculty of Education. Besides, it is also available to all users of the Independent Learning Centre (ILC).

香港作為一個充滿活力的國際大都市，市民經常有機會接觸到不同的國際盛事，能夠有效掌握英語溝通能力極為重要。然而在學習第二語言(L2)時，容易受對母語的既定感知和發音所影響。我們常常可以明顯看到母語(即漢語)影響第二語言(即英文)的讀音。這些影響會隨着年齡的增長而變得根深蒂固，對學習其他語言帶來很大的阻力。要糾正這個問題，需要持續和度身訂造的培訓系統，實踐計算機輔助發音訓練(CAPT)正是一個合適的途徑。此外，網絡技術的進步亦開闢了新的可能性，若果能夠提供一個無障礙和全天候的個性化CAPT平台，學習者便可以自定進度。我們相信一個基於互聯網的CAPT平台，可以幫助廣大的英語學習者， 達至更高水平的英語口語溝通能力。 此特別針對以廣東話為母語(L1)的成年英語學習者的系統，已在香港中文大學的英語教學單位，教育學院的部分課堂上使用，同時正在開放予香港中文大學自學中心(ILC)的學員使用。

Website 網址 : http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=261

Sensor-Integrated Active RFID Technologies for Tracking and Monitoring Food Safety and Quality
有源RFID技術配合內置傳感器以追蹤並監控食品的安全和質量

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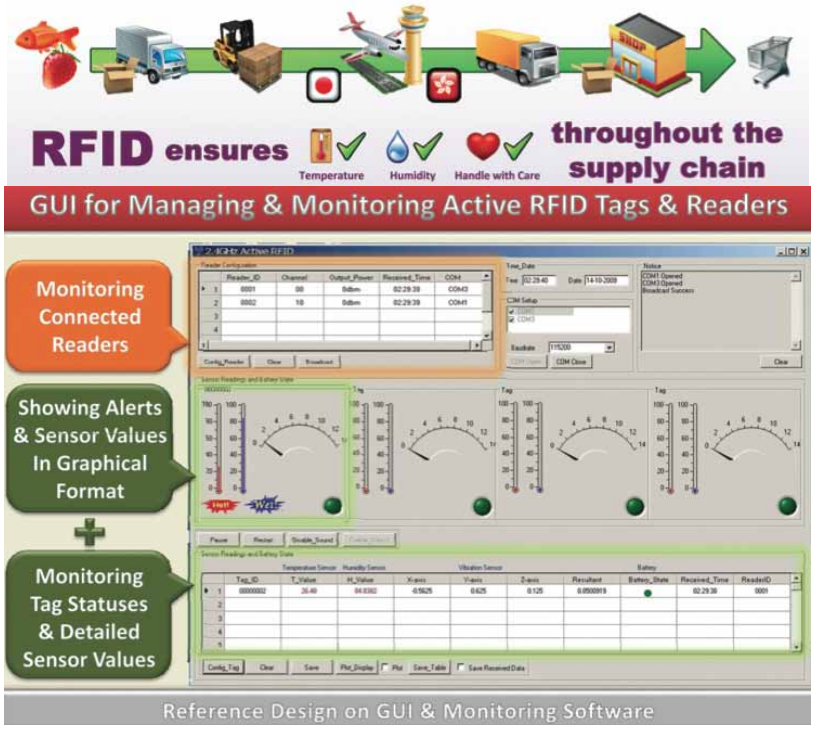
吳克利教授

Funded by Innovation and Technology Commisson
由創新科技署資助



The project developed a spectrum of sensor-integrated active RFID technologies for tracking and monitoring food safety and quality during the process of food storage and delivery throughout the whole supply chain.

The sensor-integrated active RFID technology comprises of three major components:
1.Sensor-integrated active RFID tag and reader
2.Advanced anti-collision algorithm for wireless communications
3.Communication protocol to support sensor data and tag memory management

The technology is capable of tracking different information about the food product, namely its source information, logistics, handling operations, consumption as well as the environmental data (e.g. humidity and temperature). Therefore, it can ensure a high and consistent level of food safety and quality; and facilitate Hong Kong's food quarantine, inspection and customs clearance processes.

本項目開發了一系列內置傳感器的有源RFID技術，在整個食品供應鏈內追蹤及監測食品的安全和質量。此技術亦可應用於不同的食品工業和安全設施，例如食品儲存、運送、以及冷凍貨運管理等等。

內置傳感器的有源RFID技術，主要由以下三個部分組成：
1. 內置傳感器的有源RFID標籤和解讀器
2. 防止射頻通訊時頻道衝突的先進傳信法則
3. 支援傳感器數據和標籤記憶體管理的通信協議

集合以上技術就能追蹤有關食品的不同信息，包括食品來源、物流運送、處理及消耗過程，以至整個供應過程所記錄的環境數據(如濕度、溫度等)。不單確保食品的安全和質量水平，更能促進香港在食品檢疫、檢驗及通關流程各方面的發展。

Website 網址 : http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=262

A Real-Time Indoor RFID Locationing Smart-Antenna System and Its Applications
有源RFID準確實時室內智能天線定位系統及其應用

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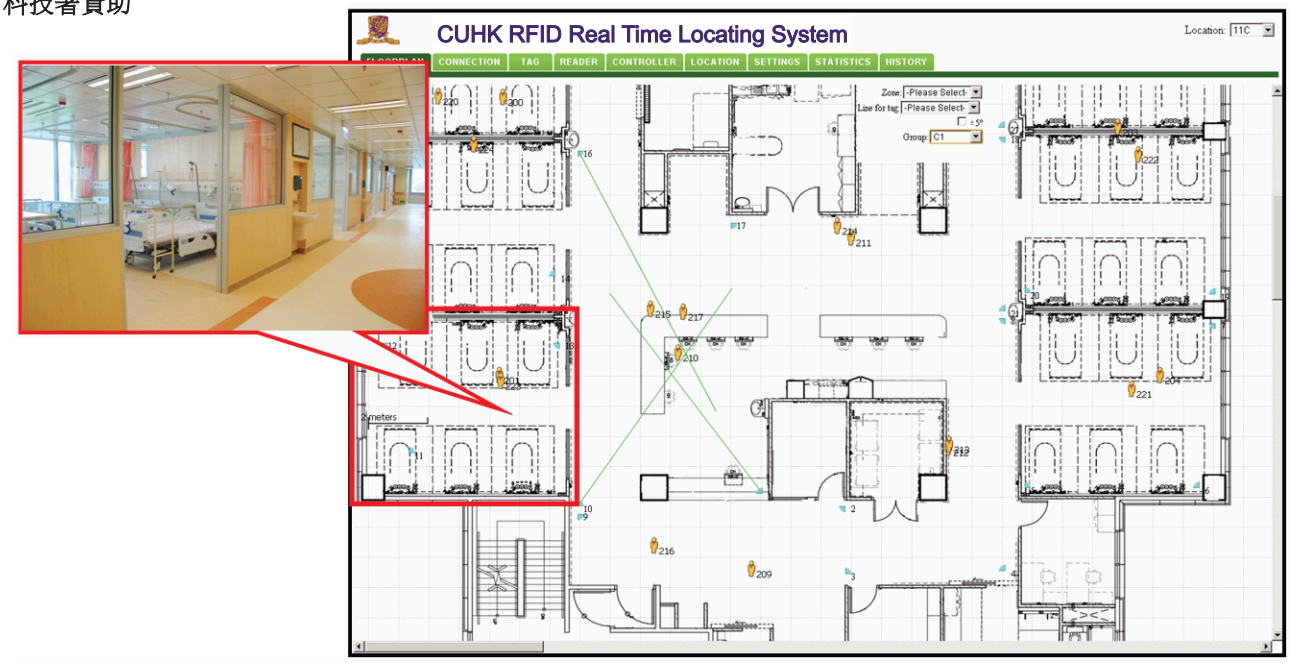
Funded by Innovation and Technology Commisson
由創新科技署資助



This system provides a total solution for various indoor applications where real time position information is critical. The system is built on a proprietary smart antenna technology and an active RFID technology at 2.4GHz. An advanced network controller allows a user defined scalable network deployed in any specific application scenarios. A universal USB interface is built in with RFID tags, which allows user-defined external sensor modules to be integrated in a specific application. A complete RFID middleware and API are also available for any large scale applications.

Potential Applications :

1. Hospital patient service, infectious disease control and valuable asset management
2. Indoor personnel tracking and logistics management
3. Warehouse management
4. Equipment flow management and real time multiple variable status monitoring

Major Technical Features :

1. Active RFID tags with a universal sensor interface
2. ± 1m positioning accuracy
3. Comprehensive RFID middleware for a large scale network application
4. Advanced anti-multipath algorithm and pre-signal processing modules
5. Capability of flexible scaling to multiple monitoring groups and zones
6. Simultaneously tracking of up to 40 tags in each user-defined monitoring group
7. Low cost tags and infrastructure equipment and easy installation procedure

實時定位信息是至關重要的，這個系統為各種室內RFID應用提供了完整解決方案。該系統是建立在一個專有的智能天線技術和2.4GHz有源RFID技術。先進的網絡控制器允許用戶在任何特定的應用場景部署可擴展的網絡。RFID標籤內建通用USB接口，用戶可視乎特定應用場合外接自定的感應器模塊。一個完整的RFID中間件和API也可用於廣泛的應用。

應用領域包括：

1. 醫院門診服務，傳染病控制和病人資產管理
2. 室內人員跟蹤及物流管理
3. 倉庫管理
4. 設備流程管理和實時多重可變狀況監控

主要的特點包括：

1. 附有通用傳感器接口的有源RFID標籤
2. 具±1米定位精度
3. 為大規模網絡應用的綜合RFID中間件
4. 先進的反多重路徑算法和前期信號處理模組
5. 靈活擴展到多個邏輯讀取組和監測區域
6. 單一監察組內可同時跟蹤多達40個標籤
7. 簡易的安裝程序及低成本標籤和硬件設備

Website 網址 : http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=249

Web Information Mining and Decision Support Platform for the Modern Service Industry
面向現代服務業的網絡資訊挖掘與輔助決策平台

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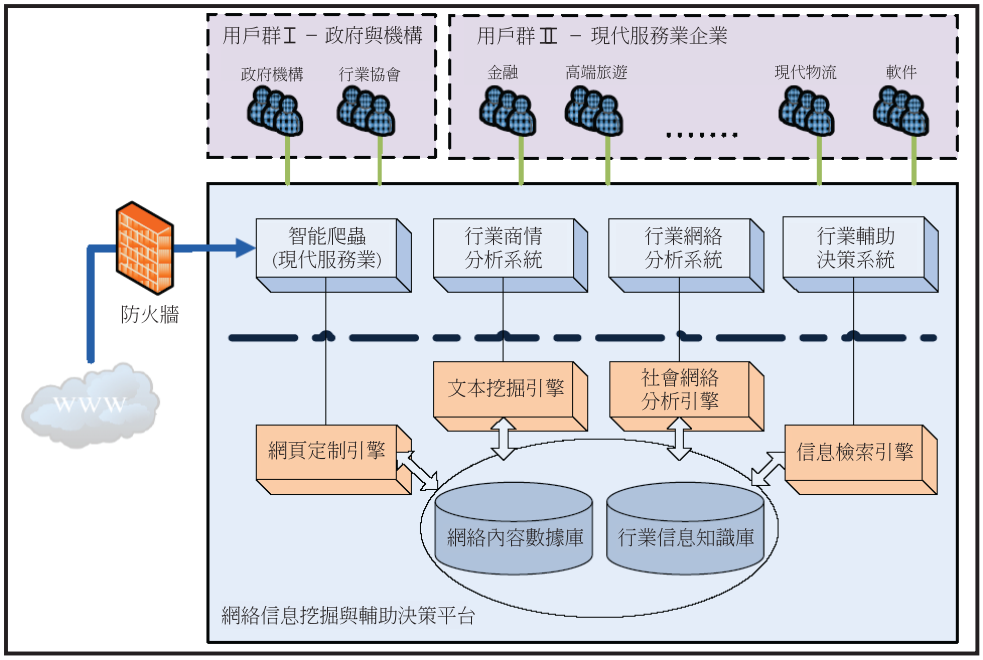
Collaboration with PKU - HKUST Shenzhen - Hong Kong Institution
合作夥伴為深港產學研基地產業發展中心



面向現代服務業的網絡資訊挖掘與輔助決策平台架構原理
System architecture of Web information mining and decision support platform for the modern service industry

This project aims to design and develop an intelligent information platform to support modern service industry between Shenzhen and Hong Kong. The platform will make use of Web Mining (WM) technique to retrieve relevant commercial information from websites in both sides, Information Extraction (IE) to extract objective Information about companies, Social Network Analysis (SNA) to analysis the social networks related to the companies, as well as Opinion Mining (OM) to mine customers' opinions about the companies. In this way, Shenzhen and Hong Kong companies can know each other better to facilitate any collaboration. Further, in their order of relative importance to Shenzhen/HK collaborative economic development, we shall apply our technology to the following application areas, innovative finance, modern logistics, advanced tourism, network information and service outsourcing.

本項目的目標是設計和開發一種智慧資訊處理平台，為香港和深圳的現代服務業提供輔助決策服務。 該平台將實現Web挖掘（Web Mining, WM）技術，在深港兩地獲取相關商業資訊；實現資訊抽取（Information Extraction, IE）技術，從網絡資訊中獲取客觀真實的企業情報；實現社會網絡分析（Social Network Analysis, SNA）技術，對企業之間的商務關係進行全面分析；實現意見挖掘（Opinion Mining, OM）技術，檢測商界和客戶對企業的各種評論。借助該平台，香港和深圳的企業能迅速形成彼此了解，達成信任，有效推進商務協作。進而，本項目研發成果將循序漸進地應用於若干現代服務業行業。以其對深港合作經濟發展的相對重要性排序，這些行業依次是創新金融、現代物流、高端旅遊、網絡資訊和服務外判。

Website 網址 : http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=253

Hybrid Silicon Waveguide Lasers
混合矽波導激光器

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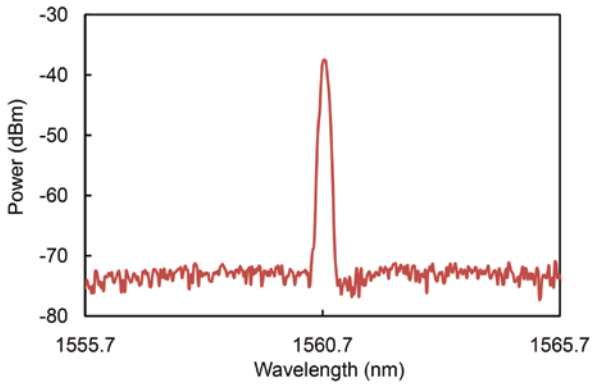
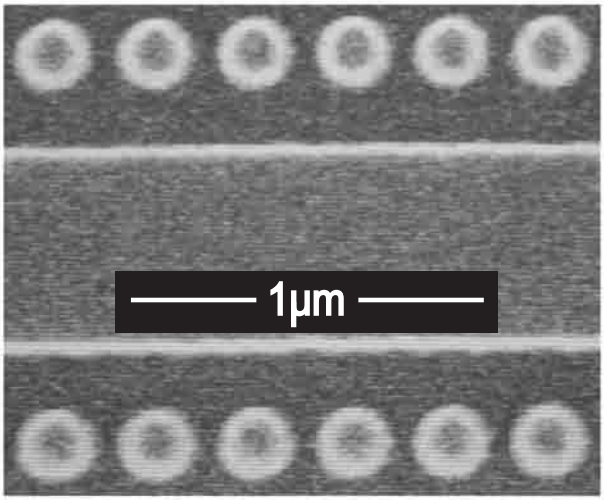
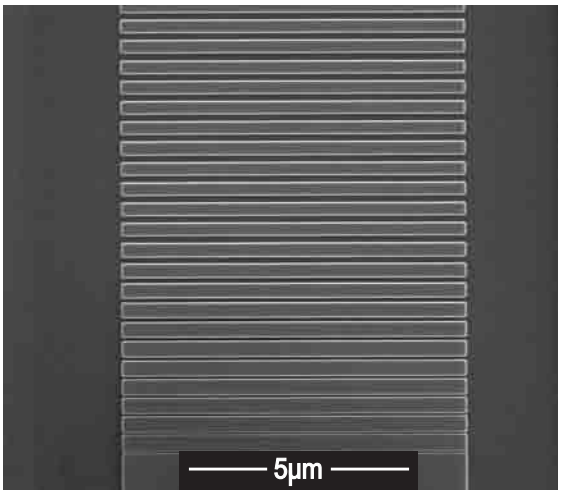
Hybrid Silicon Waveguide Laser on silicon-on-insulator (SOI) chip
在SOI上的混合矽波導激光器



The output spectrum of the Hybrid Silicon Waveguide Laser
混合矽波導激光器的輸出頻譜



The SEM image of the silicon DBR grating
電子掃描顯微鏡下的矽分布式Bragg反射光柵



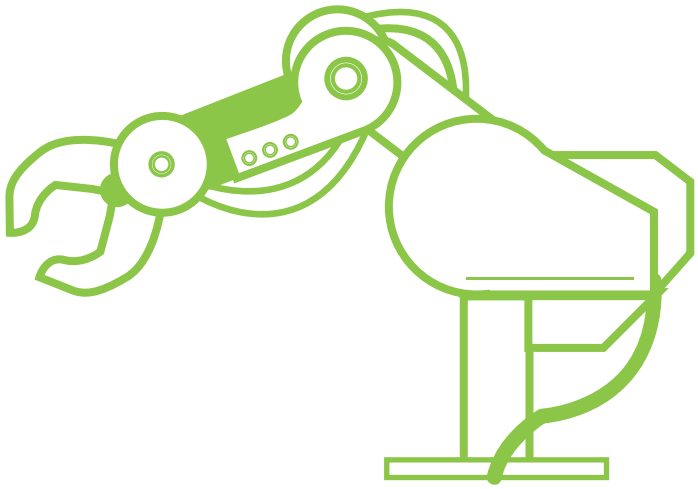
The SEM image of the silicon grating coupler
電子掃描顯微鏡下的矽光柵耦合器

Wavelength Division Multiplexing (WDM) technology is usually used in optical access networks. The high cost of conventional III-V semiconductor distributed feedback (DFB) lasers remains a crucial issue for Wavelength Division Multiplexed (WDM) optical access networks. Unlike long-haul optical fiber networks where each wavelength is shared by many end-users, the cost of each wavelength-specific channel in an optical access network is borne by only a few (or even one) end-user. We propose a low cost alternative to conventional lasers using silicon-based planar lightwave circuits (PLC). The cost of photonic packaging typically dominates the cost of an optical component and here we propose to generate multiple wavelengths but with the cost of single package. Thus the per-wavelength channel costs of the multi-wavelength WDM transmitter can potentially be several times less than a packaged DFB laser.

在現時的光纖存取網絡中，經常會使用到波分復用（WDM）的技術。其中，能產生特定波長的傳統III-V 族半導體分佈反饋（DFB）激光器，造價成本高昂成為關鍵性問題，與多用戶共享的單波長長途光傳送網絡不同，特定波長的成本是由少數（甚至一個）用戶負擔。因此，我們提出利用可以輸出不同特定波長的混合矽基平面光波導（PLC）來取代傳統的激光器，以降低成本。事實上，封裝過程佔光學元件的大部份成本，我們提出利用單一封裝過程而能產生不同特定波長的設計，令多波段波分復用傳送器中每個波段的成本，比傳統的激光器降低數倍。

Website 網址 : http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=270

機械人及自動化技術
Robotics & Automation



Treebot
爬樹機械人

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林天麟博士

Treebot can climb a wide variety of trees for inspection, maintenance, pest control and other forestry work.
爬樹機械人能在不同的樹幹爬行，協助檢查樹木、保養及病蟲害防治等林業工作。

Treebot which weighs only 600 grams is the world's lightest, smallest and most flexible tree climbing robot. Composed of a novel continuum maneuvering structure and a pair of tree grippers, Treebot has high maneuverability, adaptability and is able to attach on a wide variety of trees with a wide range of gripping curvature. It can move freely on the trunk,between branches, and reaches different location on the tree. It is equipped with tactile sensors to explore the climbing environment, so that it can climb trees autonomously. With 1.75kg payload capability, Treebot can carry instruments and assist workers in climbing trees for the inspection, maintenance, pest control or other forestry work, so as to reduce the risk of injury and improve efficiency. Treebot can also be used to monitor the arboreal environment for ecological research.

爬樹機械人僅重600克，是全球最輕、體積最小、最靈活的爬樹機械人。它主要由一個可高度伸縮及多向彎曲的獨創移動裝置和一對機械抓組成，能在不同粗細、 材質且不規則的樹幹和枝椏之間自由爬行， 到達樹上不同位置。它亦配備觸覺傳感器以探索周遭環境，從而自主設定最佳前進路線。爬樹機械人可負載重達1.75公斤的儀器，協助工人爬到樹上進行檢查、保養及病蟲害防治等林業工作，有助減低工人受傷的風險，提高工作效率，而且它亦可用於監察樹上生態以進行科學研究，用途廣泛。

Website 網址 : http://arl.mae.cuhk.edu.hk/node/678
http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=254

A Magnetorheological (MR) Fluid-Assistive Machine for Optical Element Polishing
磁流液輔助光學元件拋光機

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Funded by Innovation and Technology Commission
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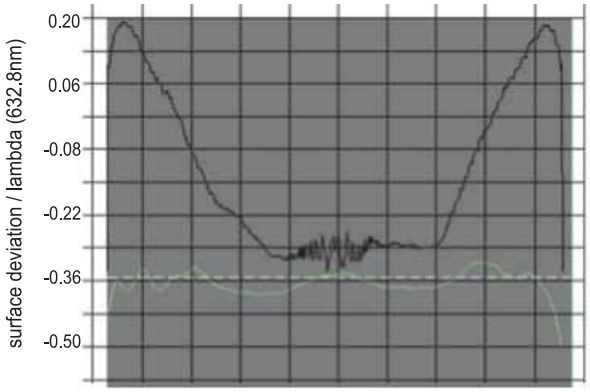
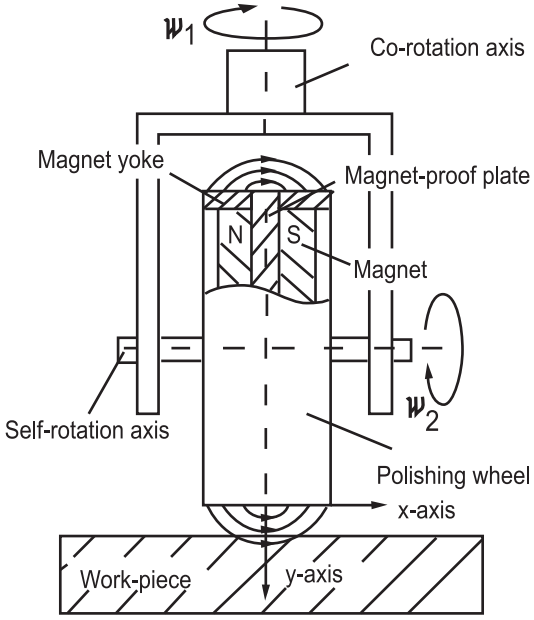
Constructed MR fluid polishing machine
設計和構建的磁流液輔助拋光機



Cross sections comparison of the 100 mm diameter optical flat at the beginning (black line) and end (green line) of polishing
100毫米直徑光學平面拋光實驗結果: 拋光前（黑線）和拋光後（綠線）的截面比較



Working concept of our MR polishing process and magnetic field pattern
我們採納的磁流液輔助拋光操作概念和磁場模式

MR fluid-assistive technology is originally developed by overseas company for high precision polishing of optical elements. In this project, we designed and constructed a rather economical MR fluid polishing machine to conduct experimental study of MR polishing technology. The key difference between our machine and the overseas machines is that a permanent magnet is being utilized in our polishing wheel to magnetize the iron particles in MR fluid. Moreover, our machine does not have a delivery system for MR fluid as in the overseas machines but feature a container instead to replenish the MR fluid onto the polishing wheel. We also adopted our own special composition of MR fluid for utilization. A circulation system to bump abrasive solution onto the workpiece through a delivery tube is also installed. Our machine also utilized feedback information from intermittent interferometric measurements to induce polishing strategy for the subsequent iteration. Experimentation results on our machine via a 100 mm diameter optical flat shows that a photovoltaic (PV) surface error of 0.285λ and a RMS surface error of 0.032λ, λ=632.8nm, can be attained.

磁流液輔助拋光是由海外公司開發的高精密光學元件拋光的技術。在這個項目中，我們設計和構建了一個比較經濟的磁流液輔助拋光機來進行實驗研究。我們的機器和海外出售的機器關鍵的區別是我們利用永久磁鐵來磁化在拋光輪上磁流液的鐵粒子。我們的機器也沒有像海外的機器一樣為磁流液設置輸送系統，而是利用一個特別容器來補充拋光輪上的磁流液。我們還為我們的機器設計了特殊成分的自用磁流液，並一個輸送磨料在工件上的循環系統。利用反饋信息，我們更從干涉測量中導出後續迭代的拋光戰略。通過一個100毫米直徑的光學平面的拋光實驗顯示，我們的機器可以達到光伏表面誤差0.285λ和均方根表面誤差0.032λ，λ= 632.8nm。

Website 網址 : http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=274

Technology Development for Design and Fabrication of Selected Free-Form Optical Elements
特選自由曲面光學元件的設計和製作的技術開發

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Specially designed nozzle for formation of magnetorheological jet
特別設計的磁流液射噴嘴以達致噴射效果

Fabricated mechanism for magnetorheological jet finishing of optical elements
構建的磁流液噴射光學元件拋光機

Freeform component is becoming a much desired feature in modern optical systems due to their marked advantages in aberration reduction, enhanced image quality, compact configuration and weight reduction, and more. The main challenge in freeform optics remains to be the lack of a practical and standardized method for the design and fabrication of its components. For design, difficulties arise in that optical properties must be obtained through the end-to-end tracing of millions of characteristics rays from source to target. On the fabrication side, due to the complicated shapes and curvatures, novel mechanisms and processes beyond traditional approaches must be envisioned. The present project aims at developing a platform to explore the design and fabrication of a selected class of freeform optical pieces. For a focus study, we will explore some of the optical design and analysis issues of the selected elements, while devoting the main effort on the mechanism construction and processing for reliable and quality fabrication of the pieces. Success of the present project will greatly elevate the industrial capabilities in Hong Kong and China in optical products that have been dominated by the US, Europe and Japan manufactures.

憑藉其在減小像差、提高像質、緊密結構以及減輕重量等方面的顯著優勢，自由曲面元件在現代光學系統中正起著日趨重要的作用。然而，自由曲面光學面對的最大挑戰，仍在於缺少一套實用而且標準化的方法來實現元件的設計和加工。設計方面的困難，在於元件的光學性能必須通過對大量特徵光線從頭至尾的跟蹤來獲得。在加工方面，由於元件形狀和曲率複雜，有必要考慮研發新型的機械裝置和加工流程來取代傳統工藝。本項目旨在開發一個用於研究自由曲面光學元件的設計與製造平台。由於自由曲面光學課題極為廣泛，我們會在選定的元件領域內，致力開發光學設計算法、並將重點集中於機械裝置以及加工過程，以實現優質可靠的製造程序。成功實行本項目，將會大大提高香港乃至內地在光學領域的工業實力，貼近具主導地位的歐美和日本製造商。

Website 網址: http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=273

WireWarping++: Robust and Flexible Surface Flattening with Length Control
WireWarping++: 可靠靈活並結合了長度控制的曲面攤平技術

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Funded by Innovation and Technology Commission and Shun Hing Institute of Advanced Engineering
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Collaboration with TPC (HK) Ltd.
合作夥伴為TPC (HK) Ltd.

Potential applications on biomedicine
這項技術在生物醫藥方面的應用

For burn injuries
治療燒傷

For varicose vein
治療靜脈曲張

For overuse injuries
治療身體勞損

(Photographs from internet)
(以上圖片來自互聯網)

Surface flattening has numerous applications in sheet manufacturing industries, such as garment industry, shoe industry, toy industry, furniture industry and ship industry. Motivated by the requirements of those industries, Wire-Warping approach presented in 2007 is exploited to generate 2D patterns with invariant length of feature and boundary curves. However, strict length constraints on all feature curves sometimes cause large distortions on 2D patterns, especially for those 3D surfaces which are highly non-developable. Thus, our research team presents a flexible and robust extension of WireWarping by introducing a new type of feature curves named elastic feature.

On these new feature curves, instead of strictly preserving the exact lengths, only the ranges of their lengths are controlled. To achieve this function, a multi-loop shape control optimization framework is proposed to find the optimized 2D shape among all possible flattening results. Besides, we also present a topology processing algorithm on the network of feature curves to eliminate cases that lead to numerical singularity. Experimental results show that the WireWarping++ can successfully flatten surface patches into 2D patterns with more flexible shape control and more robust numerical performance.

曲面攤平技術可廣泛應用於現代板材製造行業，諸如服裝業、製鞋業、玩具製造業、船舶製造業等。為了進一步改善此技術，王昌凌教授於2007年研發了WireWarping，可以在保持邊界和特徵線長度不變的情況下將三維模型攤平得到二維裁片。然而，在攤平過程中，要嚴格確保所有邊界和特徵長度不變，通常會令二維裁片出現很大誤差，尤其是當要攤平的三維模型非常不可展的時候。為解決上述問題，王教授的研究團隊提出一種可靠靈活的新攤平方法-WireWarping++。

首先將所有特徵線劃分為彈性特徵線和剛性特徵線。在攤平過程中，只有剛性特徵線的長度需要嚴格規定，而彈性特徵線的長度可以在預設的範圍內變化。為了實現這一功能，我們構架了一個多層優化體系，從而優化二維裁片形狀。除此以外，研究團隊也開發了一套拓撲處理的算法，可以處理那些使得計算不穩定的特徵線網絡拓撲結構。最終的實驗結果證明，我們的WireWarping++方法可以有效地獲得最佳形狀的二維裁片，並擁有穩定的性能。

Website 網址 : http://www2.mae.cuhk.edu.hk/~cwang/pubs/TASEWireWarping.pdf
http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=268

GPU-Based Solid Modeler for Complex Objects
基於圖形處理器的複雜形狀 - 實體建模技術

Prof. WANG Chang Ling Charlie
Miss LEUNG Yuen Shan
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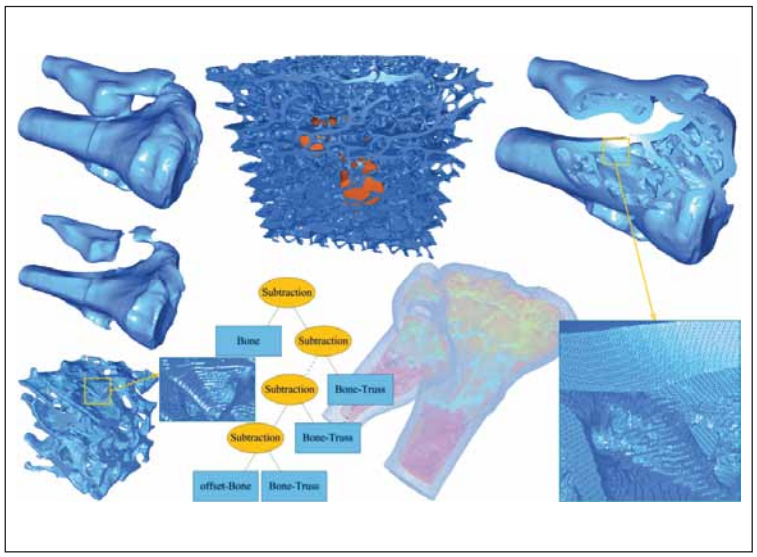
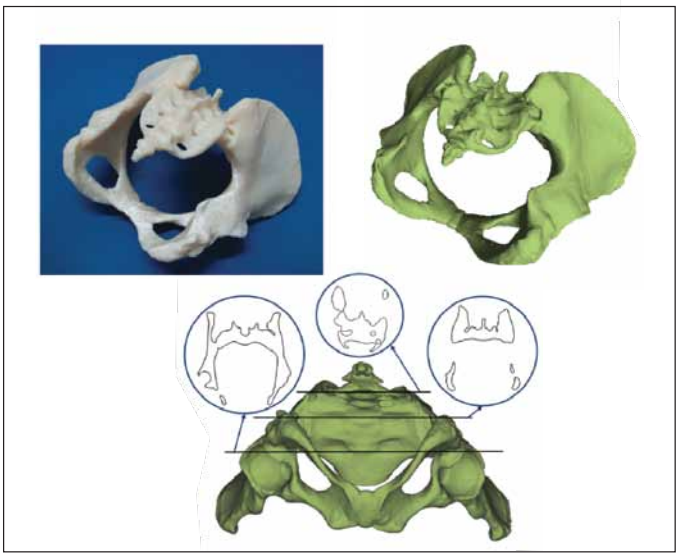
合作夥伴為美國南加州大學工業及系統工程學系陳勇教授



Highly parallel Boolean operation for osseous scaffold model
骨支架模型的高度並行布爾運算



Topologically faithful slicing of pelvis model for rapid prototyping
用於快速成型之確保拓撲的切片技術(盆骨模型例)

The market-available solid modelers (e.g., ACIS and Parasolid) use the boundary representation (B-rep) to present the shape of an object in computers, they lack of efficiency and prone to robust problems. Our research team introduces a novel solid modeling framework using Layered Depth-Normal Images (LDNI) to represent solid models. At present, the programmable components of the Graphics Processing Unit (GPU) allow the use of its high-performance parallel architecture to accelerate many graphics and scientific applications. Our representation therefore can take advantage of this architecture on modern graphics hardware and shows great improvement in efficiency. To further exploit the power of GPU, we develop a programmable rasterizer to compute highly complex model using the out-of-core strategy. Results with massive number of triangles have been successfully tested on our prototype implementation, where most of them fail on the state-of-the-art commercial (or open-source) solid modeling kernels. In addition, we develop a slicing algorithm for generating self-intersection free and topologically faithful contours from a general implicit solid. Therefore, correct objects can be fabricated in rapid prototyping, which is important to many applications, e.g. Biomedical Engineering.

目前市場上主要商用實體建模核心，如ACIS和Parasolid，採用邊界表達來描述幾何體的形狀，但是缺乏計算效率和穩定可靠的性能。中大研究團隊獨創了一套採用多層深度法向圖像（LDNI）來對實體模型進行表達的實體建模體系，它可利用擁有可編程元器件的圖形處理器並行加速，能大大提高計算效率。 不僅如此，針對數據量更大的模型，為了充分發揮圖形處理器並行計算的能力， 我們採用分流發開發了一種可編程的光柵化算法。 實驗結果證明，我們可成功處理三角形數量龐大的模型，不是其他市場上同類核心可及。此外，基於多層深度法向圖像表達，我們開發了一套切片算法。這一算法可以從廣義的隱式實體模型生成無自相交和拓撲可靠的輪廓線。因此，準確的模型可以由快速成型加工出來。此工作對於很多實際應用均有重要意義， 例如生物醫學工程。

Awards:
1) Prakash Krishnaswami CAPPD Best Paper Award, ASME 31st Computers and Information in Engineering Conference (CIE), 2011
2) VX Corporation Idea Award (2nd Place) by the research - "GPU Based Solid Modeler for Complex Objects", International CAD Conference and Exhibition, 2009
3) Best Paper Award, ASME 28th Computers and Information in Engineering Conference (CIE), 2008

Website 網址：http://www2.mae.cuhk.edu.hk/~cwang/pubs/CADGPUModeler.pdf
http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=269

Development of a Robotic System for Nasal Surgery
鼻腔手術機械人

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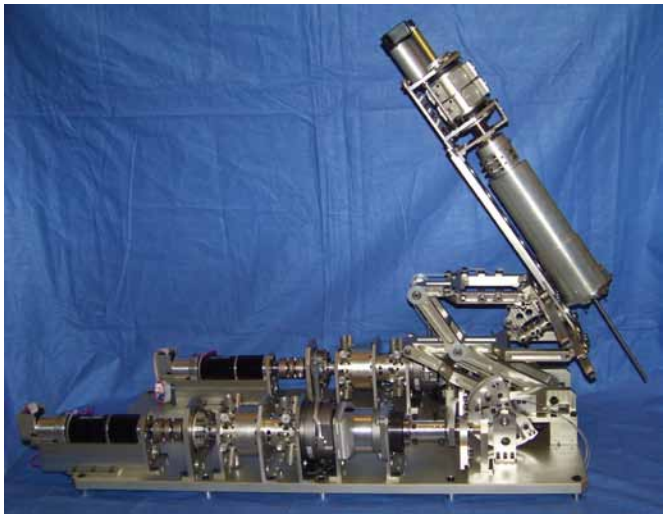
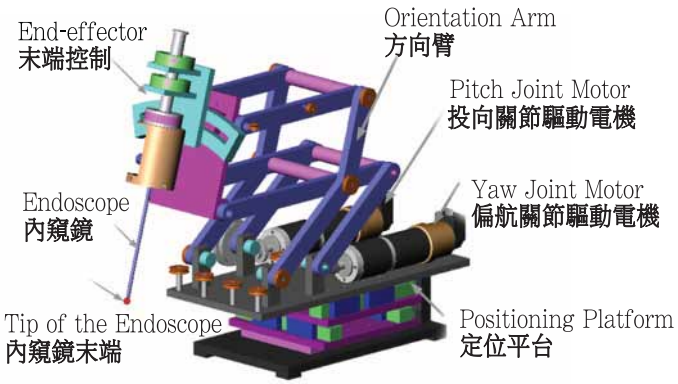
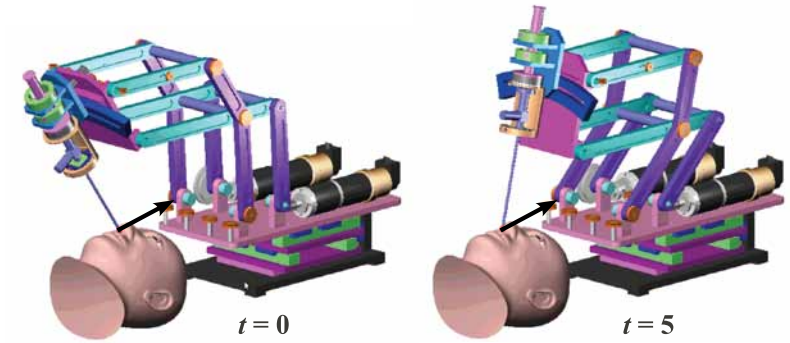
劉雲輝教授

Funded by Innovation and Technology Commission
由創新科技署資助





A prototype of robotic system for nasal surgery
鼻腔手術機械人的雛型



This project aims at developing a robotic system for holding and manipulating the endoscope for a surgeon carrying out surgical procedures in a nasal cavity. In the current practice of nasal surgery, the surgeon needs to use one hand to control an endoscope that views the nasal cavity and the other hand to manipulate the surgical instruments. The robot will release one hand of the hand-busy surgeon so that doctor's both hands can be focused on the operational procedure. Moreover, the doctor can still control motion of the endoscope himself / herself by either a friendly force- reflecting foot-controlled or a voice-controlled interface.

The robot system has a 3 degrees-of-freedom (DOF) fine-positioning device and a 4 DOF dexterous manipulator that positions and orients the endoscope inside the narrow nasal cavity. The operational safety of the proposed robotic system is guaranteed by a passive safety mechanism and an active force controller.The proposed robotic system is customized to nasal surgery and hence is of low cost compared to surgical robotic systems on the market.

本項目旨在研發一台可以操作鼻腔內窺鏡 ，協助醫生完成鼻腔手術的機械人系統。目前，醫生在進行鼻腔手術時，需要用一隻手操控內窺鏡，另一隻手操作手術工具，這會嚴重影響手術效率。本項目研發的機械人，可以代替醫生用來操控內窺鏡的一隻手，從而使雙手都能集中在手術上，而醫生仍可以自行通過腳掣或聲控介面，方便地操控機械人。

中大研究團隊所研發的機械人， 由一個三自由度的準確定位裝置和一隻四自由度靈巧機械手組成，機械手可以改變內窺鏡在鼻腔內的位置和方向。操作安全系統擁有雙重保證：分別是被動性防護結構和主動性的力度控制器。本機械人是專為鼻腔手術特別設計，優點包括：體積小、性能可靠、低成本等等。

Website 網址: http://appsvr.cintec.cuhk.edu.hk/exhibition//project.php?pid=240

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Project information is also available at
www.cintec.cuhk.edu.hk/exhibition

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