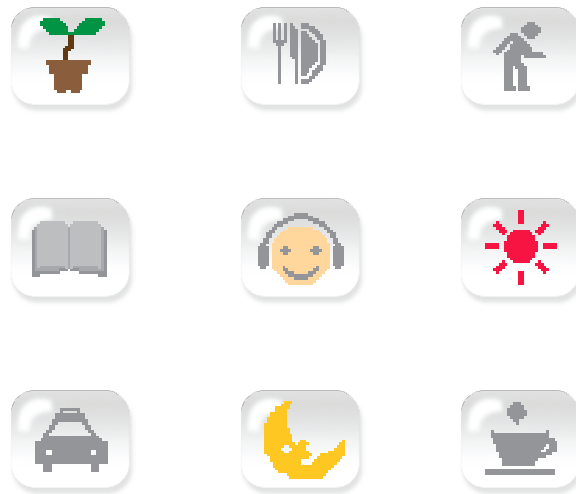香港中文大學
The Chinese University of Hong Kong

Innovation for Better Life 2010 -2011

Preface

Thank you for your interest in the innovations of The Chinese University of Hong Kong (CUHK). It is our pleasure to share with you some of the research results we generated recently.

Research and development operation adopting an "open innovation" model is to source and integrate research results or innovations from not only the inside but also the outside of a company. This will significantly expand the R&D bandwidth of the company with minimum investment. In the current era of knowledge-based economy, innovation is the prime key for success. Leading companies around the world are striving hard to improve their innovation capacity. The open innovation model is widely adopted as one of the most popular approach. CUHK is eager to support companies to execute open innovation by sharing our endogenous innovations and our innovation network worldwide.

As a consequence of population aging, climate change, and proliferation of computers, biomedical sciences, environmental and green technology, as well as information sciences are making critical impacts to our daily life. We herewith classify our projects according to the said categories for your easy reference.

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

Should you find any project of interest, you are welcome to contact us. We are pleased to provide you further information, or arrange meetings with our research teams.

序言

感謝您對香港中文大學（中大）的創意發明感興趣，我們樂意與您分享中大最近的科研成果。

研究與開發工作如採取開放性創新模式，企業不單在內部，甚至在公司以外的地方亦應能獲取和整合研究成果或發明。這樣，公司只需作出最少的投資，就能顯著地擴大研發效能。在現今知識型經濟年代，企業的致勝關鍵在於創新。世界各地的龍頭企業皆致力提升其創新能力，而開放性創新模式正是其中一種被廣泛採用的方法。中大願意與業界分享我們的校內發明以及國際間的科研網絡，以協助業界實踐開放式創新之路。

隨著人口老化、氣候劇變及電腦應用激增，生物醫藥科學、環境與綠色科技，以及訊息科學成為對我們日常生活有著舉足輕重影響的範疇。本冊子以上述範疇將各研究項目分類，以方便讀者查閱。

為減省紙張消耗，本冊子只提供項目簡介，詳細資料請瀏覽以下網頁：
www.cintec.cuhk.edu.hk/exhibition/

如對任何項目感興趣，歡迎聯絡我們，我們將提供進一步資料或安排與研究隊伍會面。

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

香港中文大學
創新科技中心主任
黃錦輝教授

目錄

Environmental & Green Technology

Environmental & Green Technology
環境與綠色科技
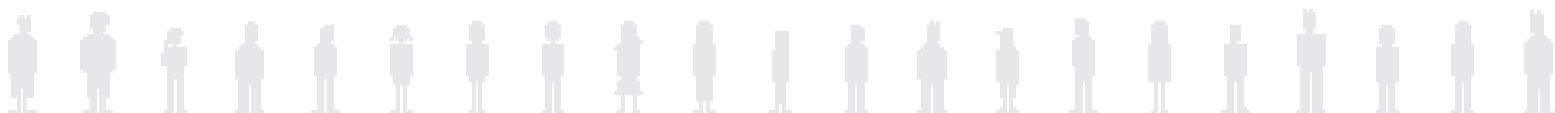
Development of a Glycan-based Blood Test for Diagnosis of Hepatitis B Virus-associated Liver Cancer

研發建基於聚糖的診斷乙型肝炎相關性肝癌的驗血技術

Hepatitis B virus-associated hepatocellular carcinoma (HBV-associated HCC) is the major type of primary liver cancer, and is a serious health problem in Hong Kong and Mainland China. A panel of verified serum aberrant N-glycans as potential tumor markers for diagnosis of the subject cancer is being developed. The target result will be a new non-invasive blood test for early diagnosis, with sensitivity and specificity reaching at least 90%.

乙型肝炎相關性肝癌是在香港及中國大陸的嚴重健康問題。我們正研發基於血清醣蛋白上的一組變異N鍵結聚糖作為肝癌的生物標誌，希望開發出能準確地診斷早期乙型肝炎相關性肝癌的驗血技術，並至少擁有90%的敏感性與特異性。

Prof. POON Chuen Wai Terence
Department of Medicine and Therapeutics

內科及藥物治療學系
潘全威教授

An Innovative Quality Control Method of Polysaccharide-rich Herbal Medicines Using Bioassay Guided High-speed Counter-current

運用活性篩選指導下的高速逆流色譜法，解決植物多糖的質控難題

Preparative High-speed Counter-current Chromatography (HSCCC) is used for the separation of polysaccharides. Compared to the conventional column separation, the proposed work has great advantages in terms of sample recovery rate, system capacity, cost, and efficiency.

應用高速逆流色譜技術於多糖的分離製備，和傳統分離方法相比，新方法在樣品回收率、製備能力、成本和效率等方面將會有較大的改進。

Prof. HAN Quan Bin
Institute of Chinese Medicine

中醫中藥研究所
韓全斌教授

The coils equipped in HSCCC.
高速逆流色譜儀中的分離管

Nanoparticle and Cocrystal Formulations of Curcumin
for Treating Alzheimer's Disease
納米粒子和共晶薑黃素配方治療阿爾茨海默氏病

Curcumin may treat Alzheimer's disease (AD), but it is poorly absorbed by the human body. Cocrystals and nanoparticles can enhance the solubility, absorption, stability and efficacy of drugs. We adopted Flash NanoPrecipitation (FNP) to produce curcumin cocrystal and nanoparticle formulations, aiming to provide improved effectiveness at treating AD.

薑黃素可治療阿爾茨海默氏病(老年癡呆症)，然而，它很難被人體吸收。不少研究均顯示納米粒子和共晶可提高藥物的溶解度、吸收、穩定性和效率。我們將透過「快速納米沉澱技術」開發薑黃素共晶及納米粒子配方，我們期望新配方可以增加預防和治療阿爾茨海默氏病的效果。
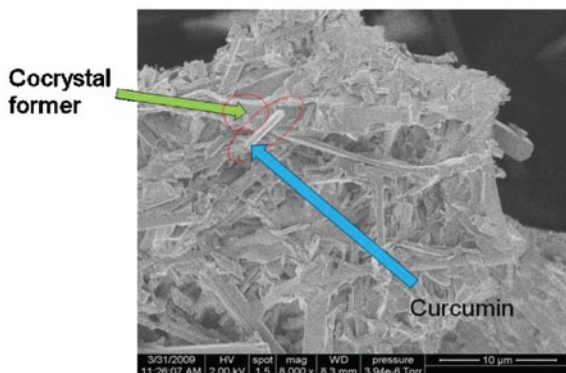
Curcumin Cocrystal under Scanning Electron Microscope
電子顯微鏡下的薑黃素共晶

Prof. BAUM Larry
Prof. CHOW Hee Lum Albert
School of Pharmacy
藥劑學院
包立怡教授
周喜林教授

Interactive Weight-bearing Exercise (iWE) Platform
互動負重運動儀

This project aims to develop an interactive weight-bearing exercise (iWE) platform using magnetic levitation to provide mechanical stimulation for musculoskeletal strengthening. Conventional designs usually employ complicated mechanics that are of high cost, high wear and tear rate. Our new design is both innovative and simple, and achieves high energy efficiency, low maintenance, low noise and low cost.

iWE platform is unique in using magnetic repulsion to float the platform and human body above the ground. This reduces mechanical friction, making the system highly energy efficient, less prone to wear-out, and quiet in operation. Different amplitudes and frequencies can be adjusted for specific clinical indications.

本項目旨在發展一種建基於互動負重運動來強化骨骼及肌肉的新型運動儀。傳統設計因使用複雜的機械結構而導致高成本及高損耗率。本設計使用既創新又簡單的結構，從而達致高效能、低維護、低噪音及低成本等效益。

互動負重運動平台特別利用了磁浮概念來使平台和人體浮起，有效減少系統的機械摩擦，既節省能源，又降低磨損，更能安靜地運作。 可調較振幅及頻率，應用於特定的臨床適應症。

Prof. LEUNG Kwok Sui
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Shoe d' Ankor – Fall Prevention Shoes for the Elderly and Patients with Risks of Fall
「安步行」– 為容易跌倒的老年人和病患者而設的安步鞋

Inappropriate footwear has been identified as one of the major reasons of fall and its related injuries among the elderly. This project aims to develop and produce shoes, that provide better foot accommodation, comfort level and biomechanics, to reduce the risk of fall among the elderly or people lacking balance ability.

穿著不合適的鞋是造成老年人跌倒並導致相關損傷的主要原因之一。本項目旨在研發並製造一種更合腳、更舒適及更符合生物力學原理的防跌鞋，藉以減少老年及缺乏平衡力人士跌倒的機會。

Fall Prevention Shoes
防跌鞋

Prof. LEUNG Kwok Sui
Department of Orthopaedics and Traumatology

矯形外科及創傷學系
梁國穗教授

Surgical Robot Arm and Training with Navigation
手術機械臂及導航訓練平台

The surgical robot arm can guide the surgeon to the target position and maintain it rigidly for bone fracture fixation. It also helps to eliminate physical tremor as well as improve accuracy and precision of surgical drilling. With the image-guided surgical navigation practice model, the system can provide simulation to facilitate the training of difficult surgical procedures with the Navigation System in vitro the training of difficult surgical procedures with the Navigation System in vitro. The new generation of the semi-active robot arm is under development with the support of the Innovation and Technology Fund and is expected to be completed in 2011.

利用手術機械臂，矯形外科(骨科)醫生可控制機械臂到手術目標體位，瞄準病人的手術位置並在斷裂的骨頭上鑽孔，用螺絲作骨折固定。手術機械臂能有效地消除骨科醫生因手持手術工具所產生的震動，大大提高手術準確性及精度。透過專為複雜的骨科手術練習而設計的手術導航訓練平台，骨科醫生能在模擬環境下進行手術前訓練。新一代的半自動式手術機械臂已獲創新科技處撥款研發，預計會於2011年完成。

Orthopaedic surgeon is performing operation with the semi-active robot arm and navigation system
骨科醫生正利用機械臂及導航系統進行骨科手術
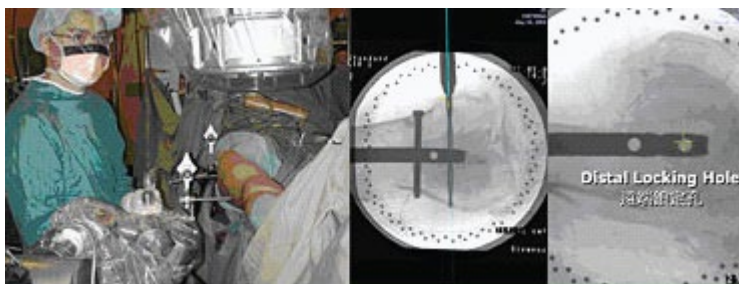
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Dr. TANG Ning
Mr. NG Wai Kin
Mr. LEE Kam Shing
Department of Orthopaedics and Traumatology

矯形外科及創傷學系
梁國穗教授
鄧寧醫生
吳偉堅先生
李鑑城先生

A Cost-effective Functional Finger Prosthesis with Rebounded Type Progressive Hinge Lock
優越成本效益的漸進式鎖鉸功能性手指義肢

Active-function artificial finger allows users to perform flexion and extension actively. However, it is expensive. We aim to design a cost-effective finger prosthesis to maintain patients' basic hand functions for daily tasks. The mechanism was inspired by the rebounded type progressive hinge lock commonly found in sofas.

現時市面上的手指義肢可提供主動伸展及屈曲的功能。然而，此產品的成本高昂。研究團隊的目標是透過研發出簡單的義肢以維持傷者日常生活的基本能力。機械設計的靈感源自梳化椅常用的分段式鎖鉸。

Prof. FONG Tik Pui Daniel
Prof. HUNG Leung Kim
Dr. HO Pak Cheong
Dr. TSE Wing Lim
Dr. WONG Wing Yee Clara
Dr. YUNG Shu Hang Patrick
Prof. CHAN Kai Ming
Mr. FUNG Ying Ki
Department of Orthopaedics and Traumatology

Prof. LIAO Wei Hsin
Department of Mechanical and Automation Engineering

Mr. AU YANG Choi Kam
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歐陽財金先生
冼世榮先生

Progressive hinge lock replaces finger joint
漸進式鎖鉸取代掌指關節

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

The proposed intelligent sprain-free shoe consists of three parts: (1) Sensing; (2) Identification; and (3) Correction. The sensor detects the ankle motion in real time. The identification part determines the sprain risk based on the data collected. When a potential sprain is identified, the correction system will be initiated. It is a myoelectric stimulation device, which delivers electric signals to the peroneal muscles at the lateral shank to correct the spraining motion.

防足踝扭傷智能鞋的機制分為(一)感應；(二)識別；(三)修正。簡單來說，智能鞋利用放置在鞋內的傳感器監測足踝運動，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。

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Dr. YUNG Shu Hang Patrick
Ms. CHAN Yue Yan
Ms. CHU Wing Shan Vikki
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何溥仁醫生

機械與自動化工程學系
廖維新教授
李文榮教授
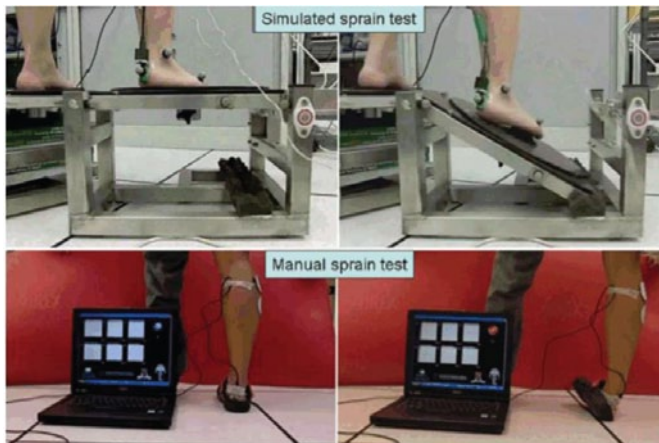
Simulated / Manual sprain test
模擬/手控扭傷測試

A Knee Rotational Laxity Meter to Evaluate Knee Rotational Stability
膝關節旋轉穩定性計量儀

This study aims to devise a knee rotational laxity meter to quantify and evaluate the knee rotational stability for clinic use, especially for orthopaedics physicians to examine patients suffering from anterior cruciate ligament rupture, and to monitor their rehabilitation progress.

本研究目的是設計一個量度膝蓋旋轉穩定性的計量儀，來量化和評估膝關節旋轉的穩定性以供臨床使用，尤其是骨科醫生檢查前十字韌帶斷裂患者，並在覆診時監察他們的康復進展情況。

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Prof. FONG Tik Pui Daniel
Prof. CHAN Kai Ming
Mr. LAM Mak Ham
Dr. LAW Kan Yip Billy
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矯形外科及創傷學系
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方廸培教授
陳啓明教授
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Prof. CHAN Wood Yee
School of Biomedical Sciences

生物醫學學院
陳活彝教授

Prof. LIAO Wei Hsin
Department of Mechanical and Automation Engineering

機械與自動化工程學系
廖維新教授
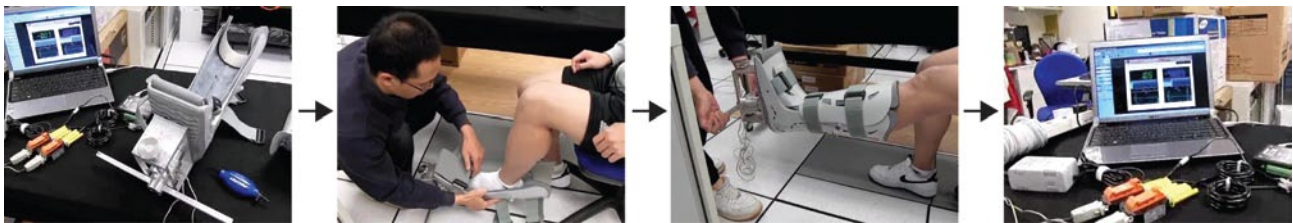
Steps of measuring knee rotation laxity
量度膝頭旋轉穩定性步驟

Development of an Immortalized Human Mesenchymal Stem Cell Line Overexpressing Thymidine Kinase (TK) Gene for Anti-tumor Therapy
建立一種用於抗腫瘤細胞治療的永生化高表達胸腺嘧啶激酶的人間充質幹細胞系
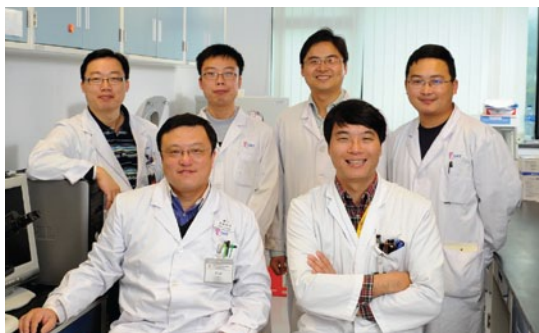
Prof. LI Gang (first row, first from left) and his research team
中文大學醫學院李嘉誠健康科學研究所幹細胞與再生醫學
李剛教授(前排左一)實驗室團隊近影。

The tumour homing properties of Mesenchymal stem cells (MSCs) make them good candidates as anti-tumor agent delivery vehicles. Cancer gene therapy employs the suicide gene(s) encoding enzymes such as herpes simplex virus thymidine kinase (HSV-TK), which can convert prodrugs (e.g. ganciclovir, GCV) with low inherent toxicity into toxic compounds and thus circumvent the systemic side effects caused by traditional chemotherapy. It is hoped that a bio-safe and immortalized human TK-MSCs cell line will be established and used in anti-cancer cell therapy clinical trials.

MSCs有很強的腫瘤靶向性，可用作攜帶抗腫瘤物質的載體細胞。腫瘤基因治療是應用自殺基因如帶狀疱疹病毒的胸腺嘧啶激酶（HSV-TK），TK 酶可以將前藥更絡西芬（Ganciclovir, GCV）由低毒性轉化為高細胞毒性，進而殺死腫瘤細胞。與傳統的化療方法相比，這方法副作用小，更具安全的特點。通過本課題的研究，希望建立一種安全的人源性永生化的TK-MSCs 細胞系，用於抗腫瘤細胞治療的臨床實驗。

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Department of Orthopaedics and Traumatology

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李剛教授

Super-paramagnetic Iron Oxide Nanoshell and PVA Based Chemoembolisation System: Novel Approach for Targeted Delivery, Selective Retention, Magnetic Targeting, and MRI.

超順磁性氧化鐵納米殼及PVA 為基礎的化學栓塞系統以達到靶向給藥、選擇性藥物停留及磁共振顯像

The aim of this project is to develop a drug delivery system to deliver specific drug to targeted organ. This can minimize undesirable side-effects of drugs on normal cells. We propose to develop a superparamagnetic iron oxide (SPIO) nanoshell based chemoembolisation system for anti-cancer drug delivery.

此研究項目旨在開發一個藥物輸送系統，運送藥物到身體特定位置，減少藥物對正常細胞的副作用，和把藥物集中在病灶。我們提出一種超順磁性氧化鐵（SPIO）納米殼為基礎的化學栓塞系統作為抗癌藥物載體。

Prof. WANG Yi Xiang
Department of Imaging and Interventional Radiology
影像及介入放射學系
王毅翔教授

Prof. LEUNG Cham Fai Ken
Center of Novel Functional Molecules, Department of Chemistry
化學系新穎功能分子研究中心
梁湛輝教授

Intestinal Polyp Image Recognition System

腸道息肉影像識別系統

Capsule endoscopy is one of the methods for intestinal examination. The camera inside the capsule takes 50,000 photos of the intestinal conditions. Physicians need to spend an average of two hours to view all the photos taken in order to identify areas with abnormal conditions, such as polyp or bleeding. To solve this problem, our research team invented an 'Intestinal Polyp Recognition System for Capsule Endoscopy Images'. The prototype system was tested to achieve 94% accuracy.

膠囊內視鏡是腸道檢查的其中一種方法。膠囊內視鏡逗留體內期間，其內置鏡頭會拍下腸道約五萬張照片，醫生一般需要花平均兩小時檢閱全部照片。有見及此，研究小組發明了一套「腸道息肉影像自動識別系統」，提升檢閱照片的效率。研究團隊曾以本地病人的腸道照片進行測試，發現系統的準確度高達94%。
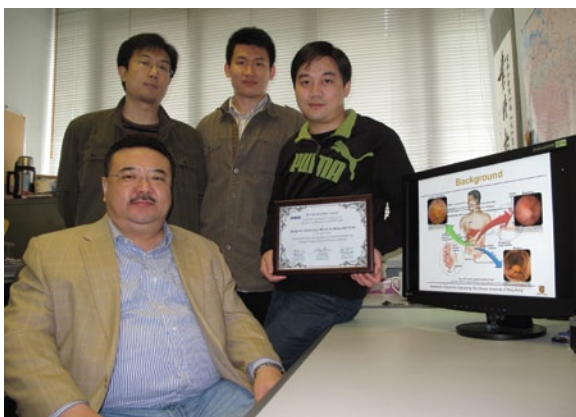
Prof. MENG Qing Hu Max
Dr. LI Bao Pu
Department of Electronic Engineering

電子工程學系
孟慶虎教授
李抱朴博士

Prof. MENG Qing Hu Max (front) and his PhD students
(from left): QI Lin, FAN Yi Chen Simon, and LI Bao Pu
孟慶虎教授（前）及其博士研究生（左起）：齊林、范奕辰及李抱朴

Development of a Wireless Robotic
Capsule Endoscope with External Guidance
一種外部引導的無線驅動膠囊內窺鏡的研製

Since the movement of current capsule endoscope for gastrointestinal tract inspection is not controllable, missing diagnosis is possible. We are developing an external localization module to track the moving trajectory and control the orientation of the capsule. An internal locomotion mechanism at the capsule makes the propulsion.

由於一般用於腸道疾病檢查的膠囊內窺鏡完全沒有控制裝置，拍攝圖像有一定的隨機性，因此存有漏檢的可能。我們正研發一種外部導航系統，計算出膠囊在三維空間中的位置和方向信息，從而實現對膠囊的跟蹤定位及進行方向引導，而牽引力則由膠囊內部驅動結構提供。

Prof. MENG Qing Hu Max
Department of Electronic Engineering
電子工程學系
孟慶虎教授
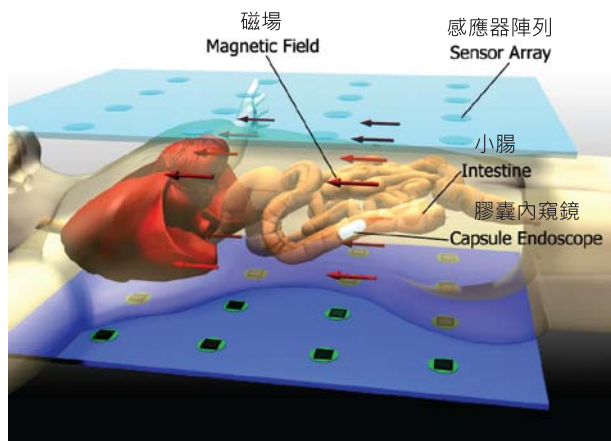
Using magnetic field to drive capsule endoscope
利用磁場驅動腸道內的膠囊內窺鏡

Vascular Intervention Simulation System
血管介入治療模擬系統

Safe and effective performance of precise Vascular Intervention Radiology (VIR) procedures requires highly skilled doctors with specialized training. We are developing a 'Vascular Intervention Simulation System' to facilitate training of common vascular intervention procedures. The system makes use of patients' data to reconstruct the 3D anatomic model of organs and vascular network, and simulate the whole VIR procedures. The system can greatly enhance the effectiveness of VIR training.

透視微創手術要求極精確的手術技巧，醫生必須有足夠培訓才能安全有效地操作手術。我們正研發一個用於便於訓練常見血管介入手法的血管介入治療模擬系統。系統利用病人數據，重建血管網等不同組織的三維解剖影像，模擬整個透視微創手術的過程，大大促進培訓成效。

Prof. HENG Pheng Ann
Department of Computer Science and Engineering

Prof. YU Chun Ho Simon
Department of Diagnostic Radiology and Organ Imaging

計算機科學與工程學系
王平安教授

放射診斷學系
余俊豪教授

Vascular intervention simulation system for medical training
用作培訓醫護人員的血管介入治療模擬系統

Smart Assistive Knee Braces Utilizing Magnetorheological Fluids

磁流變智能助力膝架

Assistive tools for knee movement provide mobility support to elderly or disabled people. We developed a "Smart Hybrid Assistive Knee Brace" that uses an actuator to integrate electric motor (MR) with magneto-rheological fluids. Motor function provides the active torque for climbing stairs while MR brake part provides the passive torque for walking down the stairs and works as a cushion to protect the knee. The proposed system is more comfortable to user, it also consumes less power as compared to motor-driven devices.

身體衰退的老年人以及行動不便者的活動能力受到嚴重限制，可見協助膝部活動的輔助儀器的需求非常龐大。 中大研究隊伍採用一種名為「磁流變液」的智能液體製成磁流變驅動器，結合馬達功能，成功開發「智能混合助力膝架」。當人體需要主動的助力（如上樓梯時），磁流變驅動器可將馬達部分產生的力量傳遞到膝架上，給予使用者足夠的力量上樓梯；當人體需要被動的助力（如下樓梯時），磁流變驅動器制動部份可以單獨操作，發揮軟墊一般的作用，令膝架有足夠的柔韌度，以幫助用者行走。另外，控制磁流變液所用的電量也遠比運作馬達少 。

Prof. LIAO Wei Hsin
Department of Mechanical and Automation Engineering

Prof. FONG Tik Pui Daniel
Prof. CHAN Kai Ming
Department of Orthopaedics and Traumatology

機械與自動化工程學系
廖維新教授

矯形外科及創傷學系
方廸培教授
陳啓明教授
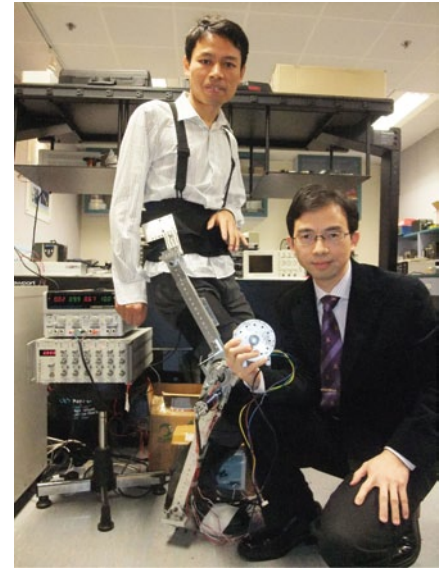
Prof. LIAO Wei Hsin (right) developes hybrid assistive knee braces with smart actuators
廖維新教授（右）成功開發
「智能混合助力膝架」

RFID Logistics Monitoring System
射頻標籤物流監控系統

When active radio frequency identification (RFID) technology is used for intelligent logistics monitoring, the built-in sensors of the RFID tag can monitor the temperature, humidity and vibration of the cargo on which the tag is attached. The data collected inside the container can be transmitted to the receiver through the radio to alert the worker to make corrective adjustment if necessary. The system contributes to the efficiency of the industry and to ensuring quality of the goods under transportation and storage.

利用有源射頻標籤技術的智能物流監控系統，其特色在於標籤內裝有多種傳感器用以量度所附物件的溫度、濕度及振動情況。用家只須將標籤貼於貨箱內，傳感器便可將所讀得的數據通過無線電發送到接收器。當數據超出預設的標準，系統便會即時發出警報，讓運輸工人能及時作出調整。這項技術將大大貢獻物流業，不但保障貨品質素，更可提升運輸效率。

Prof. WU Ke Li
Department of Electronic Engineering
電子工程學系
吳克利教授

Awarded Gold Award of Hong Kong RFID Awards 2009
獲2009年度香港無線射頻識別大獎金獎

Spatial and Appearance Correlation of Multi-view Surveillance Videos for In-store Customer Trace Discovery and Pro-active Selling
有利店內顧客跟踪和主動銷售的多視點監視視頻的空間和外觀相關技術

We are developing a spatial and appearance correlation of multi-view surveillance video technology, which is aimed for in-store customer trace discovery and pro-active selling strategy. With the customer trace information obtained, customer behavior can be analyzed in real-time. Together with other information such as age group and gender information captured by the entrance surveillance camera, profiling of the customer or demographic information can be used for personalized advertisement on networked interactive digital signage.

我們正發展空間和外觀相關的多視角視頻監控技術，此技術有助於跟踪店內客戶及採取積極主動銷售策略。透過追蹤店內客戶，可以即時分析顧客行為，加上大門上監察攝錄機所取得之性別和年齡組別資料，系統就可以根據客戶的統計數據訂出針對當事人的廣告，在他經過的電子告示板上恰當地播出。

Blue line on the floor plan (left) illustrates the path and staying time of a customer.
平面圖上的藍線（左）顯示客戶的路徑和停留時間。

Networked interactive digital signage (NIDS) (right) will show appropriate advertisement to recall customer's purchase desire.
交互式數字網絡標牌（右）將顯示適當的廣告，提高顧客的購買慾。

Prof. LYU Rung Tsong Michael
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Visible and Infrared Video Integrated Marking
for Augmented Gesture Extraction (VIVid IMAGE)
為增強姿勢提取的可見光和紅外線視頻綜合可塑印記技術

The VIVid IMAGE is a video processing toolkit to facilitate applications of augmented gesture extraction technologies in computer gam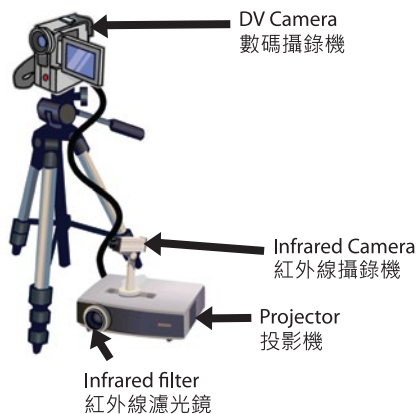es and digital entertainment. The system requires the application of visible and infrared video and innovative integrated marking technology, where the Infrared Projection Marker can dynamically change its pattern and be recognized to determine the shape and 3D position of the target object, thus providing augmented gesture extraction calculation (such as movement of hand or head).

這研究項目提供增強姿勢提取能力和發展視頻處理工具包，可應用於電腦遊戲及數碼娛樂等範圍，此技術運用可見光和紅外線的視頻，以及創新的綜合標識，使到用紅外線所投影的標記可以動態改變圖樣，有效地識別目標物件的形狀和立體位置以致計算及確認影像中的的姿勢（如手勢、點頭等）資料。

Projector-Camera Pair Set up
攝像機和投影機組合

DV Camera
數碼攝錄機

Infrared Camera
紅外線攝錄機

Projector
投影機

Infrared filter
紅外線濾光鏡

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Hand-in-Hand: Feel Your Touch over the Internet
網上手牽手：通過互聯網感受觸碰

This project aims at developing a low-cost online hand-in-hand system. A surface electromyography sensor is used to detect the feeble electric signals generated during muscle contraction. By analysing and transmitting the features of such electric signals, the robotic hand at the other end of the Internet can instantly imitate the original motion of the human hand and offer a haptic feeling.

本項目的目標是設計一個低成本的網上握手系統，透過「表面肌電感測器」檢測人手肌肉收縮時所產生的微弱電訊號，再將訊號分析並傳送到網絡另一端的機械手上，機械手就能實時重複人手的動作，達致傳遞動作及觸感的目的。

Prof. LIU Yun Hui
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劉雲輝教授

Internet
互聯網

EMG sensor
表面肌電感應器
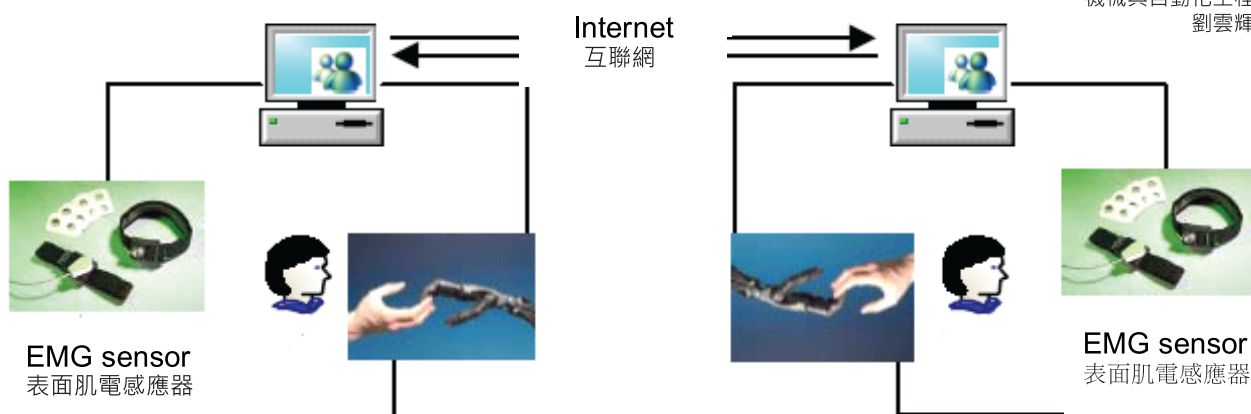
EMG sensor
表面肌電感應器

Surface electromyography (EMG) sensor has to be attached to user's forearm to detect the electric signals generated during muscle contraction. Those signals will be transmitted to the other end through Internet. Robot hand at the other side can imitate similar motion by received signal.

用者只須在前臂配戴「表面肌電感測器」，感測器便能檢測肌肉收縮時所產生的電訊號。這些電訊號會傳送到網絡另一端的機械手上，機械手就能實時重複人手本身的動作。

An Assistive Communication Brain-computer Interface for Traditional Chinese Character Input: the P300 Chinese Speller
輔助性繁體漢字輸入的腦機接口：P300 漢字拼字機

Subject is performing an experiment
實驗對象正進行實驗

Most people are able to communicate by speaking, by writing, or by signing. However, a substantial minority of people have experienced damage to their nervous system that limits their ability to control muscle movement, in some cases preventing them from communicating with others. Various brain–computer interfaces (BCIs) have been proposed that allow alphanumeric characters to be written on a computer screen by measuring a user's brain waves. However, no such device exists for individuals whose native language is Chinese. In this project, a prototype BCI that measures a user's brain waves to write Chinese characters on a computer screen will be developed.

大部分人都能通過說話、書寫、手語等來溝通。不過，有相當部分的人卻因為腦部或神經系統受損，使他們不能自由控制隨意肌的運動，甚至喪失溝通能力。目前的腦機接口 (BCIs) 只容許字母和數字的輸入，市場上仍缺乏可供輸入中文的同類系統。本研究項目將會研發一個透過量度腦電波來輸入漢字的原型系統。

Prof. WANG Shi Yuan William
Language Engineering Laboratory, Department of Electronic Engineering
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An Internet-based Platform with Automatic Speech Recognition Technologies to Support Online Computer-aided Pronunciation Training 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

We aim to research and develop automatic speech recognition (ASR) technologies that support computer-aided pronunciation training (CAPT) for Chinese learners of English. We focus especially on adult learners whose primary language is Cantonese and related transfer effects that the mother tongue has on second language acquisition. Our current system can automatically detect and diagnose a Chinese learner's salient English mispronunciations in real time.
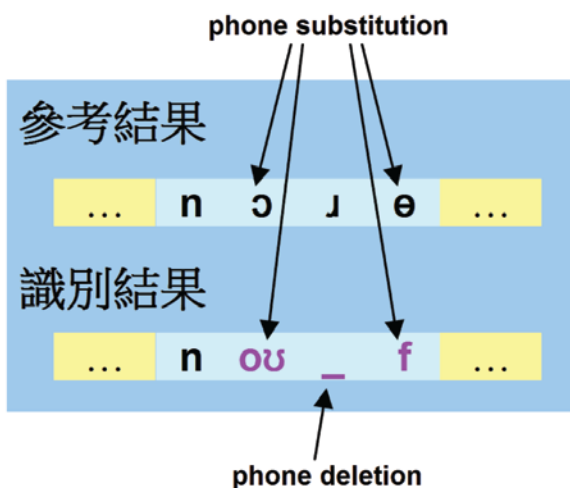
我們的研發目標是透過自動語音識別（ASR）技術，實踐計算機輔助發音訓練（CAPT），我們特別注重以廣東話為母語的成年英語學習者，探討他們在學習第二種語言時，因其母語而出現的轉移效應。這是一套初步研發完成的電腦輔助發音訓練系統，能即時並自動感應和診斷中國人錯誤的英語發音。兼備教學和矯正的指引，別具成效。

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Dr. LO Wai Kit
Department of Systems Engineering and Engineering Management

Dr. LEE Kit Lin Pauline
Independent Learning Centre

Prof. YIP Choy Yin Virginia
Department of Linguistics and Modern Languages

系統工程與工程管理學系
蒙美玲教授
盧偉傑博士

語文自學中心
李潔連博士

語言學及現代語言系
葉彩燕教授

The CAPT system can pinpoint the erroneous pronunciations of Chinese learners and diagnose the errors (indicated in purple) 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 (以紫色顯示)，並提供改善指引。

Line-rate Network Traffic Monitoring Using Multi-Core Architectures
以多核心架構作線速網絡流量監測

The goal of this project is to develop a practical, deployable system that supports line-rate network traffic monitoring for high-speed networks. We design and implement a parallel network monitoring system prototype using general-purpose multi-core architectures. We develop an efficient core synchronization mechanism that enables multiple cores to parallelize network traffic analysis with minimal performance penalty.

本項目旨在發展一個實用、可使用的支援線速網絡流量監控高速網絡系統。我們在通用多核心架構上，設計及開發一個並行網絡監控系統的原型，發展出一個有效的核心同步機制，令多核並行網絡流量分析在最小的性能損失下運行。
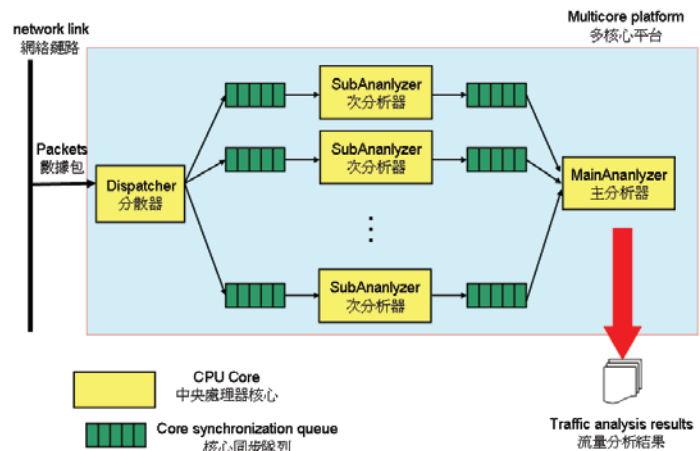
Prof. LEE Pak Ching Patrick
Department of Computer Science and Engineering

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李柏晴教授

Structure-based ASCII Art
基於結構的「顏文字」藝術

ASCII art is composed by text characters, in which nice ones can only be made manually before. We propose a novel shape similarity metric to automatically find the best matched characters to form the ASCII image. Our results are comparable to those by ASCII artists and sometimes even better.

以電腦字母及符號砌成的「顏文字」圖畫，一向只能靠人手製作。本項目提出一個嶄新的形狀相似度衡量方法，能自動找出跟圖案形狀最相似的字母或符號，再砌成「顏文字」圖畫。輸出結果可與人手製作的作品相媲美，甚至更加巧妙。
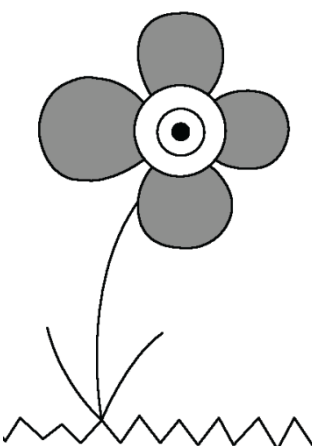
Prof. WONG Tien Tsin
Department of Computer Science and Engineering

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(a) Reference image
參照圖像

(b) Tone-based ASCII art
基於色調的ASCII藝術

(c) Structure-based ASCII art
基於結構的ASCII藝術

(d) One more result by us
另一個ASCII藝術

Interactive Image Inpainting
互動式圖像修復

Image inpainting is a process to remove unexpected objects from images and fill in missing information. Existing image processing software prioritizes the speed of processing over quality of inpainting, while our method makes a balance between the two. It makes use of all the information within the image to be guidelines, and fill the missing region quickly with the most appropriate color and structure.

圖像修復是將圖片中多餘的物件移除，再填上不存在於圖片內的背景。常用的圖像處理軟件，往往犧牲修復質素以縮短處理時間。而我們的方法卻平衡了這兩方面，以整幅圖片作為修復的根據，快速並合理地填上最合適的顏色及結構。

Prof. WANG Chang Ling Charlie
Mr. KWOK Tsz Ho
Department of Mechanical and Automation Engineering

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王昌凌教授
郭子豪先生

Original image
原有圖像

Using Adobe Photoshop CS5 to remove the red ring
利用Adobe Photoshop CS5 移除紅環後之結果

Using our technology to remove the red ring
利用我們的技術移除紅環後結果

Gradient-directed Composition of Multi-exposure Images
梯度指導下的多重曝光影像融合

We propose a simple but effective multi-exposure composition technique which aims at producing one well-exposed image that is virtually impossible with a single shot by compositing a stack of photos at different exposures. Comparing with conventional high dynamic range (HDR) imaging methods, our technique is appealing in practice since it is more efficient, easy to use and applicable in both static and dynamic scenes.

本項目提出一種簡單而有效的多重曝光影像融合技術，即通過融合多幅不同曝光的照片來合成一幅單次拍攝不可能得到的良好曝光圖像。與傳統的高動態範圍（HDR）技術相比，此方法效率高，易於使用，靜態及動態場景均適用。

Prof. CHAM Wai Kuen
Mr. ZHANG Wei
Department of Electronic Engineering

電子工程學系
湛偉權教授
張偉先生

Gradient-directed Composition of Multi-exposure Images
梯度指導下的多重曝光圖

Single Image Focus Editing
單幅圖像定焦編輯

The system can accomplish single image focus editing tasks which includes focus map estimation, image refocusing and defocusing. By using post-processing only, the system can help overcome the optical limitations and create different kinds of novel photos with desired focus setting from an imperfect photo.

此系統可以完成單幅圖片的定焦編輯任務，其中包括估計定焦圖、重置圖像焦點以及散焦。此系統僅用後處理的手段就可以克服照相機硬件限制，把一幅定焦有瑕疵的圖像變成多幅具不同定焦效果的新圖像。

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Mr. ZHANG Wei
Department of Electronic Engineering

電子工程學系
湛偉權教授
張偉先生

Single image focus editing
單圖像定焦編輯

Input image
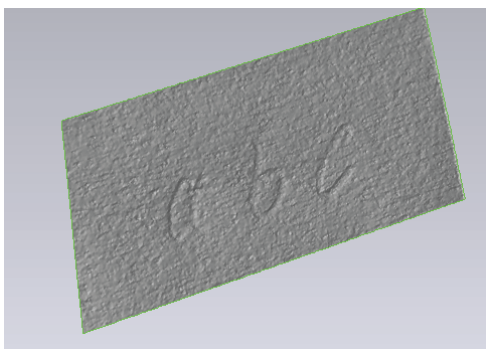Focusing on the foreground
輸入圖像焦點聚在前面物件上

Synthesized image
with shallower DOF
合成圖像的景深較淺

Synthesized
all-focused image
合成全聚焦圖像

Synthesized image
Focusing on the background
合成圖像焦點聚在背景上

Scratch Revealing in 3D
利用3D掃瞄技術呈現筆痕

Scanning image of a slice of paper with handwriting
負有字跡紙條的掃瞄圖像

We use the latest micro-projection technology to devise a super-high resolution 3D reconstruction system. With novel structure-light coding and decoding and calibration algorithms, accuracy in microns can be achieved in seconds. The system can be used to reconstruct micro details of surfaces, including 3D print on paper left from handwriting, and scratches etc. It has vast applications in precision industry, counterfeit coin detection, and handwriting identification in 3D.

本研究首次將微型投影技術引入到三維重構與測量系統中，通過創新的結構光編碼與解碼演算法，實現了微米級的三維測量精度。該系統可重構出字跡、刻痕等微觀三維形貌，並用於工業測量、字跡鑒定與恢復等用途上。

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Dr. SONG Zhan
Department of Mechanical and Automation Engineering

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宋展博士

Fast 3D Fingerprint Acquisition System
快速三維指紋獲取系統

Existing 3D scanning systems are expensive and of formidable size. In this research, a low-cost and portable 3D system is developed, which is capable of recovering 3D details of fingerprint and skin surface in a short time. The system can aid in fingerprint recognition system and medical analysis of skin surface.

現有的三維指紋與皮膚重構技術多採用三維掃瞄方式，因此系統體積較大，成本也較高。而本研究則以極低成本的硬件實現快速而精確的指紋及皮膚三維建模。該系統可用於三維指紋識別，以及醫學上皮膚的三維分析等用途。

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Dr. SONG Zhan
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宋展博士

3D scanning images of thumb and palm
拇指及手掌的三維掃瞄圖像

Interactive Haptics Modeling of Dynamic Surfaces
動態物體的交互式高效觸控模擬

This project is to develop a realistic force-sensing model based on Hertz Contact Theory. It proposed an efficient haptic constraint modeling using interactive metaballs. It realizes online touch-enabled dynamic Loop subdivision surfaces and establishes the GPU-accelerated interactive haptic scene navigation framework. The technology is useful for interactive computer animations.

本項目基於赫茲接觸理論開發真實感觸控模型，提出基於互動性元球的高效觸控約束模擬，實現網上可觸碰的交互動態Loop細分曲面，建立GPU加速的交互觸控導航系統框架。這技術可應用於交互式電腦動畫用途。

Prof. SUN Han Qiu
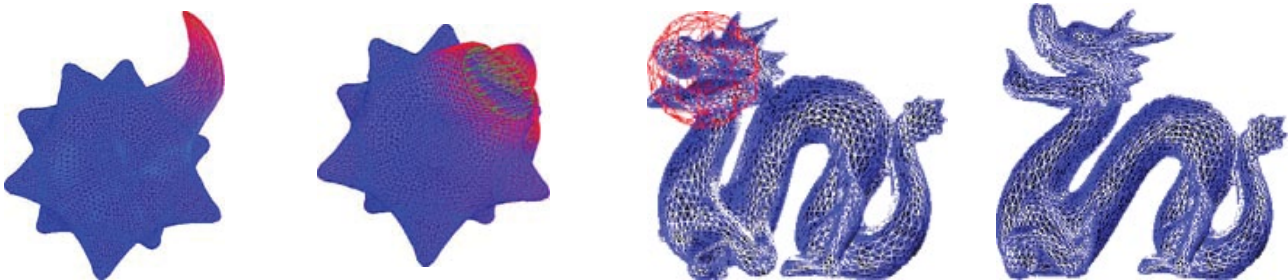Department of Computer Science and Engineering

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Image Examples
圖像舉例

# Development of Tracking and Focusing Actuators for Optical Pickup Devices
光學拾音器的循跡與聚焦驅動器開發

In order to record and play back HD contents, larger data storage capacities discs have been proposed to meet the demands nowadays. Tracking and focusing abilities are crucial to today's increasingly high-speed and miniaturized devices such as optical pickup heads for optical disk drivers (ODDs). In this project, a piezo-based pickup head for the small form factor ODDs has been developed. It is not only for precision positioning but also shock resistance.

為了記錄以及播放高清的節目內容，容量更大的光碟格式被開發用以儲存高品質的影音。因此，光碟機驅動器裡的光學拾音器循跡與聚焦能力顯得尤為重要。本計劃開發一種新穎纖巧的光學拾音器，不但滿足精密定位要求並具有抗振的能力。

Prof. LIAO Wei Hsin
Department of Mechanical and Automation Engineering

機械與自動化工程學系
廖維新教授
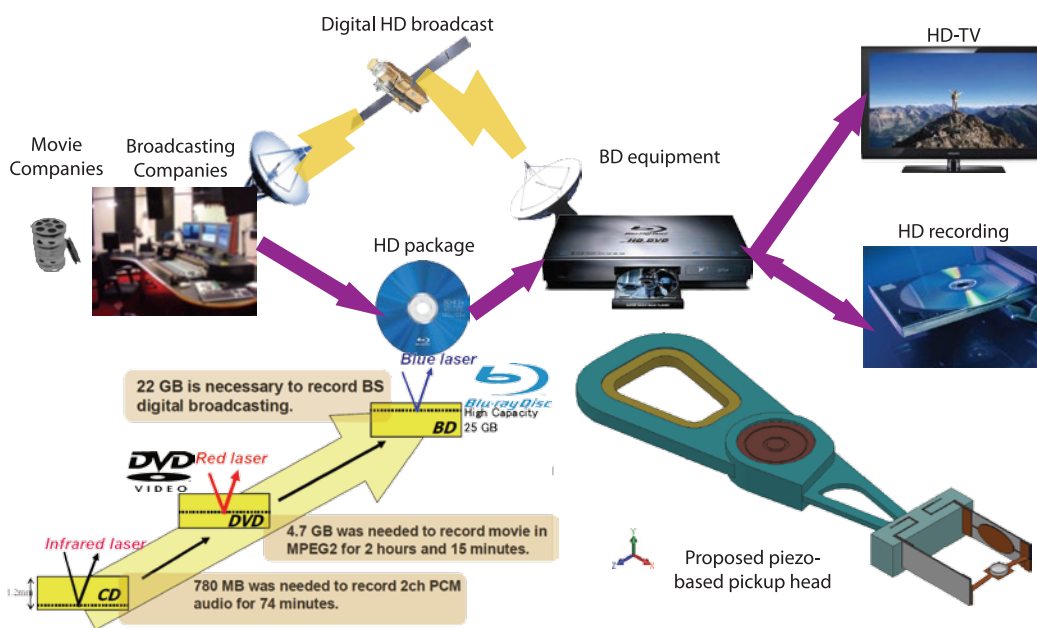
Development of Coastal Environment Monitoring and Prediction System (CEMAPS) in Hong Kong and Pearl River Delta Region

香港及珠江三角洲地區海岸帶環境監測與預測系統開發

Coastal regions are vulnerable to natural and manmade hazards, such as flooding, storm erosion, pollution, red tides, oil spills, etc. The Coastal Environment Monitoring and Prediction System (CEMAPS) will provide remote sensing and in situ data for monitoring coastal environment in Hong Kong and Pearl River Delta (PRD). It will assist decision/policy makers in the design, monitoring, detection and responding to coastal hazard.

沿海地區時有發生自然和人為災害如風暴潮、污染、紅潮以及海面溢油等。海岸環境監測和預報系統（CEMAPS）將提供香港及珠江三角地區的遙感及實地監測數據來監測海岸環境和發生的災害。該系統將協助決策者製定政策及幫助相關人員在設計上、監測上及檢測上如何應對沿海災害。

Prof. ZHANG Yuan Zhi
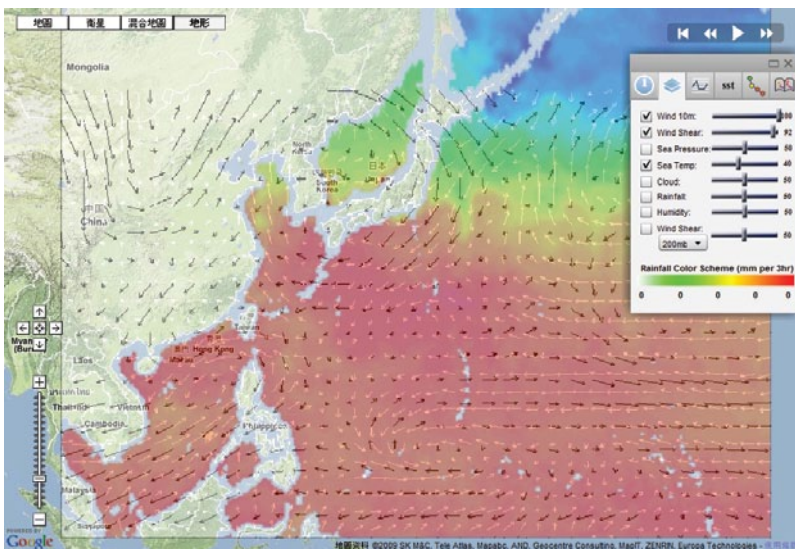*The Institute of Space and Earth Information Science*

太空與地球信息科學研究所
張淵智教授
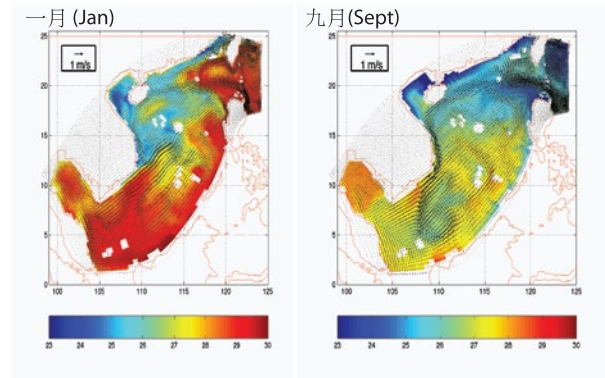
Sea surface temperature and currents in Jan and Sept
一月和九月的海面溫度和海流向量分佈圖。

Web-based System for Typhoon Analysis and Prediction

網上颱風分析及預報系統

Super-imposed Layers
重疊顯示多種颱風數據

This system is a web-based platform developed on top of Google Map for typhoon analysis and forecasting. It can show various typhoon data in layers at the same time to facilitate analysis. The powerful data mining algorithm allows users to search for similar past typhoon records based on the starting point or path of typhoon, and forecast the direction of typhoon.

本系統是一個建於 Google Map 之上的網上颱風分析及預報平台，能同時重疊顯示多種颱風數據，以方便分析。強大的數據挖掘算法，讓用戶可以按颱風的起始點或行走路徑等資料搜尋過往相類似的颱風記錄，以預測颱風未來的走勢。

計算機科學與工程學系
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Prof. LEUNG Kwong Sak
Prof. WONG Man Hon
Mr. WONG Ka Chun
Mr. ZHANG Wei
Mr. CHAN Chun Sing
Mr. MAK Seng Hin
Department of Computer Science and Engineering

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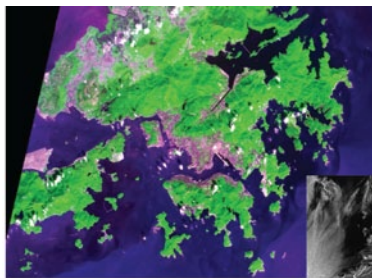*Department of Geography and Resource Management*

Build and Operate CBERS-02B Satellite Ground Receiving Station to Support Earth Resources and Environmental Monitoring

建立和運行CBERS-02B遙感衛星地面接收站以支援地球資源和環境監察

With the China National Space Administration (CNSA)'s supports, this proposed project aims (1) to establish new ground facility to receive CBERS-02B data; (2) synergistic use of ENVISAT ASAR and CBERS-02B data to develop new multi-spectra satellite data products for earth resources and environmental monitoring applications; and (3) to promote the new data products and to establish collaborating projects with partners in Guangdong province.

得到國家航天局的支持，本項目將：(1) 建立地面設備以接收 CBERS-02B 衛星數據；(2) 結合 ENVISAT ASAR 微波及 CBERS-02B 光學數據，開發多光譜數衛星數據產品以支持地球資源及環境監察應用；(3) 推廣所開發的衛星數據產品，並與廣東省內的協作伙伴建立合作計畫。

Prof. LIN Hui
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Timely multiple satellites, multiple spectral bands and in all-weather environmental monitoring
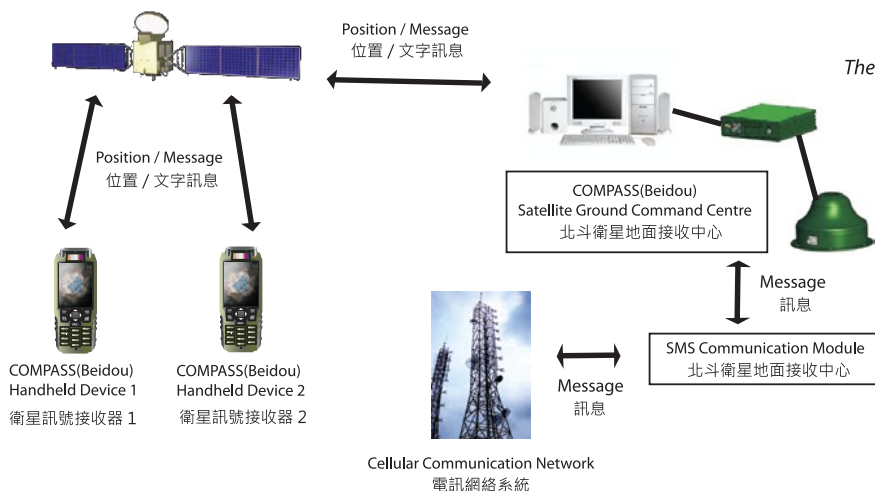多衛星，多光譜，全天候的環境監察。
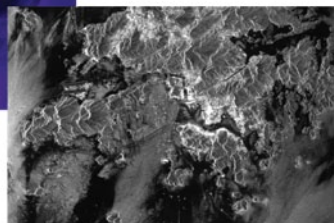
China-Brazil Earth Resources Satellite (CBERS-23)
(Source: China Academy of Space Technology)
中巴地球資源衛星-23星 (來源: 中國空間技術研究院)

Development of Multiple Sources Marine Positioning Services Using COMPASS (Beidou) Navigation System

利用北斗衛星導航系統開發多信息源海洋定位服務

COMPASS (Beidou) Navigation System, invested by China, is designed consisting of 35 satellites and will provide 24-hour global satellite navigation capability by 2010. The service cost of Beidou is no more than 5% of existing systems such as Inmarsat. This project will develop an application platform for seamless integration of multiple navigation data sources, thus enabling local industries to explore the huge business potential of Beidou.

北斗衛星導航系統是中國的投資，系統計劃在 2010 年開始運行， 整個系統 完成後將由35顆衛星組成，屆時將提供24小時全天候的全球定位服務。北斗系統服務成本僅是 Inmarsat 的 5％以下。此項目旨在開發為整合多種導航數據源提供一個應用平台。將提供機會讓本地工業界探索北斗系統的巨大商業潛力。

Position / Message
位置 / 文字訊息

Prof. LIN Hui
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Position / Message
位置 / 文字訊息

COMPASS(Beidou)
Satellite Ground Command Centre
北斗衛星地面接收中心

Message
訊息

SMS Communication Module
北斗衛星地面接收中心

COMPASS(Beidou)
Handheld Device 1
衛星訊號接收器 1

COMPASS(Beidou)
Handheld Device 2
衛星訊號接收器 2

Message
訊息

Cellular Communication Network
電訊網絡系統

The Use of Plasmonic Crystals to Increase the Efficiency of LEDs
利用等離子漿晶體以增強發光二極管的發光效率

Due to the higher refractive index of light-emitting materials, emission from Light Emitting Diodes (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, we are able to channel emission to the electromagnetic resonance modes present on the array rather than being lost in the internal reflection. This technology may be used to significantly increase the efficiency of LEDs.

由於發光材料的折射率較高，故發光二極管存著高全內反射問題，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。以此用作提高發光二極管的發光效率。

Prof. ONG Hock Chun Daniel
Mr. HUI Koon Chung
Department of Physics

物理系
王福俊教授
許冠中先生

Left: At layer of silver was coated on fluorescent material. Light emission efficiency is low due to energy lose in total internal reflection.

左圖：光滑銀層鍍在熒光材料上。發光效率低，能量主要損耗在全內反射上。

Right: When 2D silver hole array was coated on fluorescent material, light emission efficiency enhanced drastically nearly 550 times.

右圖：當二維陣列鍍在熒光材料上，發光效率便提高550倍。

Miniature Compression Refrigeration System
微型壓縮式製冷系統

Miniature air conditioning systems are increasingly used in industry: cooling for CPU/GPU chips, cooling for medical / bioengineering systems, and personal cooling. We designed and built two miniature and efficient cooling systems based on compression refrigeration. One is for CPU cooling and the other is for personal use.

近年來，微型製冷系統應用越來越多，例如CPU及GPU的冷卻、醫學及生物工程設備的冷卻，以及個人空調。我們採用壓縮製冷的方法，效率高、體積小。目前，我們已設計並製作了兩台樣機，一台是CPU/GPU冷卻系統，一台是個人空調。

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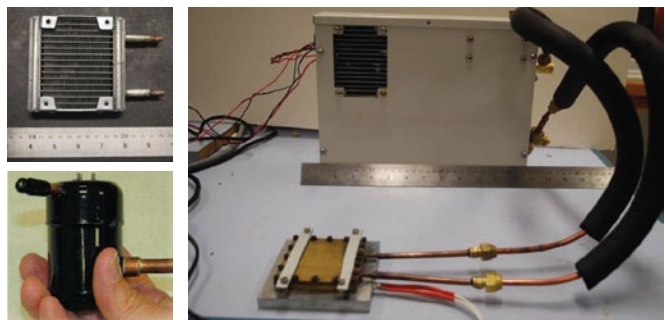
CPU / GPU chips cooling system
CPU/GPU 冷卻系統

Min-power Logic Error Cancellation - Further Extend What Clock Gating Can Do for Low Power

取消邏輯錯誤以達至低功耗－進一步擴展門控時鐘電路技術在低功耗設計的應用

We propose a green IC design technique for extra power savings by applying a new notion of logic error cancellations. In this technique, logic errors injected by disabling certain sequential elements for power savings are masked (or neutralized) by other logic errors such that the circuit functionality can be maintained while with extra power savings achieved. Up to 30% of dynamic power can be saved.

我們提出了一個綠色IC設計技術來減少能源消耗，其概念在於應用對邏輯錯誤之引入及取消。這技術以引入一些邏輯錯誤到某些循序元件，然後通過邏輯運算再引入另外一些邏輯錯誤，從而令到看起來沒有邏輯錯誤及降低能源消耗，高達30%的動能可被節省。
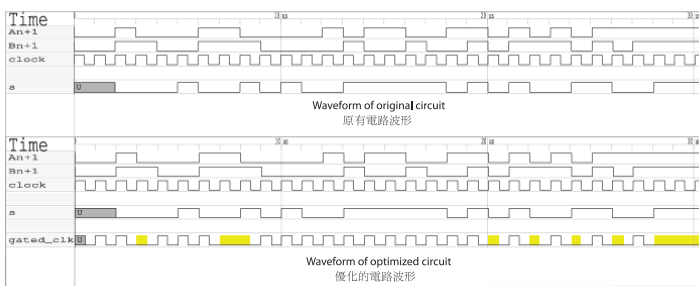
Prof. WU Yu Liang David
*Department of Computer Science and Engineering*
計算機科學及工程學系
吳有亮教授

Low-power Clock Recovery Circuit for UHF RFID EPC Class-1 Generation-2 Transponders

適用於EPC第二代第一類UHF射頻標籤的低功耗參考時鐘線路

The invention is about a new technique to generate a precise reference clock signal digitally for the digital modules in an RFID transponder. The key advantage of the invention is its low power consumption, which can be less than 2 μW. This advantage can contribute to a long RFID reading distance, combining with other low power RFID circuits. At the same time, a high clock frequency precision meeting the EPC C1-G2 standard is guaranteed by a digital calibration algorithm that is a part of the invention.

本發明是關於一種應用於UHF EPC C1-G2 RFID標籤上的數字式的精確參照時鐘信號產生辦法的新技術。本發明的關鍵優點是低功耗（可小於2微瓦）。結合其他RFID低功耗電路，這種優勢可以實現更長的RFID讀取距離。同時，通過一個數字校準算法，該電路保證時鐘頻率精度達到EPC C1－G2的標準。該算法是本發明的一個組成部分。
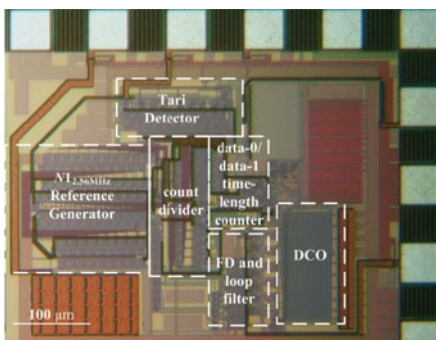
Prof. PUN Kang Pang
Department of Electronic Engineering
電子工程學系
潘江鵬教授

為減省紙張消耗，本冊子只提供項目簡介，詳細資料請瀏覽以下網頁：
To reduce our paper consumption, we only provide short summaries of our projects here.
Detailed information can be found at the website:

www.cintec.cuhk.edu.hk/exhibition/

If you are interested in any of the projects listed, please contact
Centre for Innovation and Technology
The Chinese University of Hong Kong

如 閣下對目錄內任何科研項目有興趣
請與 香港中文大學創新科技中心 聯絡