Life Sciences & Medicine 生命科學與醫學

Fast and reliable bone decalcifying technology
高速可靠的骨骼脫鈣技術

Dr Guo showing how
the Rapid Ultrasonic Decalcifier works
郭博士展示高速超聲波脫鈣系統的運作

Dr Guo Xia (left) and Prof. Zheng Yongping
郭霞博士(左)和鄭永平教授

Dr Guo Xia, Associate Professor of the Department of Rehabilitation Sciences, and Prof. Zheng Yongping of the Department of Health Technology and Informatics, have jointly designed a Rapid Ultrasonic Decalcifier to accelerate the process of bone decalcification for pathological diagnosis, bone-grafting in orthopaedic and plastic surgeries. Decalcification is a key step in making bones soft and easy to process into thin sections for microscopic investigation.

While the traditional procedure is complicated and takes months to complete, the new technology can achieve decalcification within a few days or even hours to remove calcium ions from the bone. The decalcifier works in conjunction with a special foaming agent, which activates upon contact with ultrasonic waves to produce cavitation effects, to thoroughly remove calcium ions in a short time. In addition, the machine has an end-point detection control and a temperature controlling function that prevent the deterioration of the biological properties of the decalcifying bone.

Laboratories and hospitals in Hong Kong, Taiwan, the Chinese mainland, Australia and the US have tried the new system and rated it positively. This patented system won a Gold medal at the Korea International Women's Invention Exposition 2008 and a Silver Medal at the 38th International Exhibition of Inventions of Geneva.

康復治療科學系副教授郭霞博士和醫療科技及資訊學系鄭永平教授共同研發的高速超聲波脫鈣系統可以加快脫鈣過程，以配合醫療診斷、骨移植與整形手術的用途。脫鈣是令骨組織變軟的主要步驟，以方便將骨切割成薄片，在顯微鏡下作詳細分析。

傳統的脫鈣技術繁複，往往需時數月才可完成，新技術卻只需數天甚至數小時便可以清除鈣離子，完成脫鈣程序。這脫鈣系統需要配合一種特別的泡沫溶液一起運作，當泡沫溶液遇到超聲波，就會產生空化作用，並徹底地在短時間內清除鈣離子。另外，這儀器亦配備了一個脫鈣終點偵查系統及溫度調控功能，以防止脫鈣後的骨失去其生物鑑識特徵。

香港、台灣、中國內地、澳洲及美國的一些實驗室和醫院都曾試用系統，並給予正面的評價。這套已取得專利的系統在二零零八年韓國國際婦女發明展中奪得金獎，以及在第三十八屆日內瓦國際發明展中獲得銀獎。❂

Physical Sciences 自然科學

Thin liquid layer found near the surface of glassy polymer films
玻璃態聚合物薄膜表層發現薄液態層
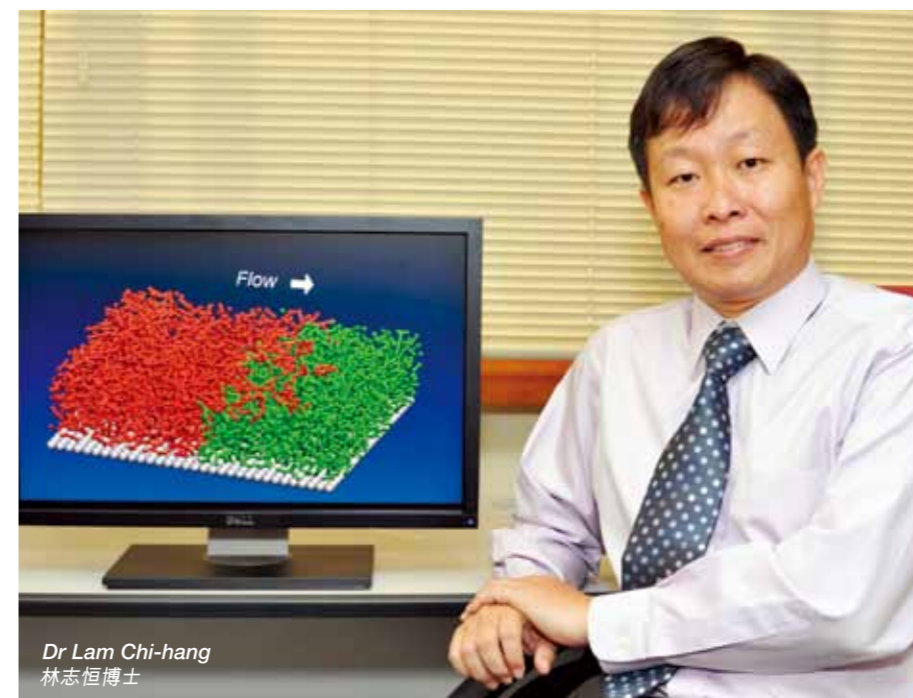
Dr Lam Chi-hang
林志恒博士

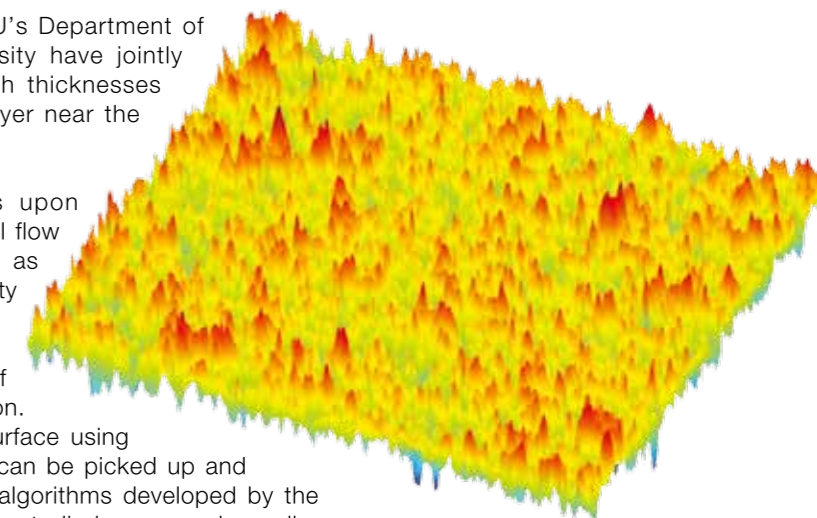理大應用物理系副教授林志恒博士與波士頓大學的物理學家合作進行研究，發現玻璃態聚合物薄膜的表層上存在著一極薄且流動性甚高，而其厚度在納米範圍的液態層。

液體一般在冷卻時會變得愈來愈黏稠，有些液體可達至不能流動的程度，這便成了所謂的玻璃。研究人員將納米厚的聚苯乙烯沈積在矽片上並測量其黏度，該聚合物由於熱力致動及與矽分子的相互作用而產生微速的亂流。其表面的幾何形態可用原子力顯微鏡連續成像，繼而得知該表面的任何流動效應，研究人員再用自行開發的特定程式以量度出精確的黏度。在最薄的薄膜中所測得的黏度數值出乎意料之低，並且出現表面傳輸的特徵。

研究小組更成功研發出一個數學模型，並以其解釋所得到的全套黏度數據，肯定地得出聚合物薄膜表層仍保持液態的結論。這些發現已刊載於「科學」雜誌（二零一零年六月二十五日）。❂

Dr Lam Chi-hang, Associate Professor of the PolyU's Department of Applied Physics, and physicists at Boston University have jointly discovered the existence of an extremely thin, with thicknesses in the nanometre range, and highly mobile liquid layer near the surface of glassy polymer films.

Liquids in general become increasingly viscous upon cooling. Some liquids can become so viscous that all flow is essentially prohibited and they are then classified as glasses. In this study, researchers measured the viscosity of nanometre-thick polystyrene films deposited on silicon. The polymer was set to flow randomly at microscopic velocities by the combined effects of thermal activation and molecular interaction with silicon. By continuously imaging the geometry of the film surface using an atomic force microscope, the effects of the flow can be picked up and the viscosity accurately measured using specialized algorithms developed by the researchers. The viscosity values for the thinnest films studied were much smaller than expected and exhibited features characteristic of surface transport.

Microscopic morphological details
of a polymer film
聚合物薄膜的微觀幾何形態

The research team successfully created a mathematical model accounting for the full viscosity data set and unambiguously concluded that a thin surface layer of the polymeric glass remains in the liquid state. The finding was released in Science (25 June 2010 issue).

Physical Sciences 自然科學

Using nanotechnology to enhance transistor performance
善用納米技術 提升晶體管性能

Organic thin-film transistor memory device
有機薄膜晶體管儲存裝置
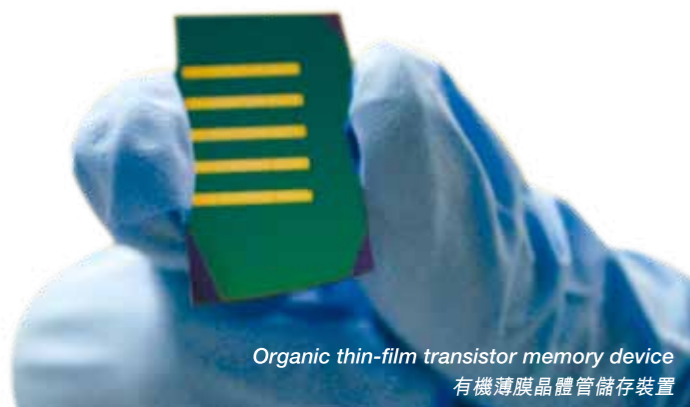
PolyU researchers have discovered that sandwiching a layer of silver nanoparticles between organic transistors, which are commonly used in consumer electronics, will significantly improve the performance of the transistors and cut down the production cost and enhance the performance of memory devices such as touchscreens and book readers.

Led by Dr Paddy Chan Kwok-leung, Assistant Professor of the Department of Mechanical Engineering, and Dr Leung Chi-wah, Assistant Professor of the Department of Applied Physics, with postdoctoral research fellow Dr Sumei Wang as one of the key members, the research was supported by funding from the Research Grants Council and the University.

Organic transistors involve the use of organic semiconducting compounds in electronic components. Using nanotechnology, organic transistors can be made thinner with improved performance. The PolyU researchers found that the thickness of the nanoparticle layer changes the memory device performance in a predictable way, thereby optimizing transistor performance to meet application requirements. Organic transistors made with a one-nanometer nanoparticle layer have stable memory that lasts for three hours, making them suitable for use as memory buffers. Transistors with a five-nanometer-thick layer can retain their charge for a much longer time. In addition, the technology is highly compatible with the low-cost, continuous roll-to-roll fabrication technique used in producing organic electronics.

The research findings of this research were published in *Applied Physics Letters* (August 2010 issue) issued by the American Institute of Physics and featured in *ScienceDaily*. The work was also presented in the September issue of *Chemical Engineering Progress*, a publication of the American Institute of Chemical Engineers.

理大研究人員發現，在常用於電子消費品的有機晶體管中間夾附一層銀納米粒子，可大大提升晶體管的性能，更可減低輕觸式螢幕和電子書等儲存裝置的生產成本，並增強其性能。

該研究由機械工程學系助理教授陳國樑博士及應用物理學系助理教授梁志華博士領導，博士後研究人員王素梅博士亦為團隊的重要成員，有關研究獲得研究資助局及大學撥款資助。

有機晶體管使用有機半導體材料作為電子器件的活性層。納米技術可用以生產更薄的晶體管，並提升晶體管的性能。理大研究人員發現，納米粒子層的厚度能以可預測的方式改善儲存裝置的性能，並進一步優化晶體管記憶的性能，以滿足應用所需。由一納米厚的納米粒子層製備的有機晶體管具有穩定的記憶性能，可連續使用三小時，因此適用於緩衝記憶，而五納米厚的納米粒子層就能把電荷保存更長的時間。這項技術更能夠與低成本的連續卷軸式有機晶體管製造技術相互兼容。

該研究結果已於由美國物理協會出版的《應用物理快報》（*Applied Physics Letters*）（二零一零年八月號）上發表，並獲《每日科學》網站報導；更刊載於由美國化學工程師會出版的《化工進展》期刊（九月號）。❖
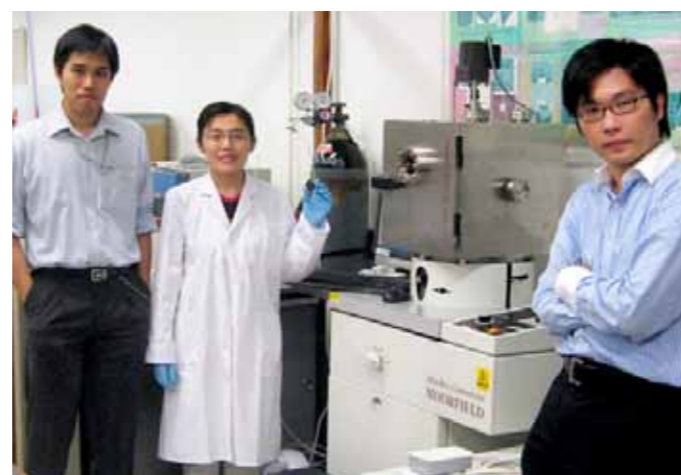
From right: Drs Chan Kwok-leung, Sumei Wang and Leung Chi-wah
右起：陳國樑博士、王素梅博士及梁志華博士

Engineering and Technology 工程學與科技

Intelligent system improves container terminal operation
智能系統提升集裝箱碼頭運作效率

Developed by Prof. Eric Ngai of the Department of Management and Marketing and his teammates from the Department of Logistics and Maritime Studies, the Intelligent Context-aware Decision Support System for Container Terminal Monitoring is able to monitor the real-time status and locations of equipment and trucks in a container terminal at a low cost.
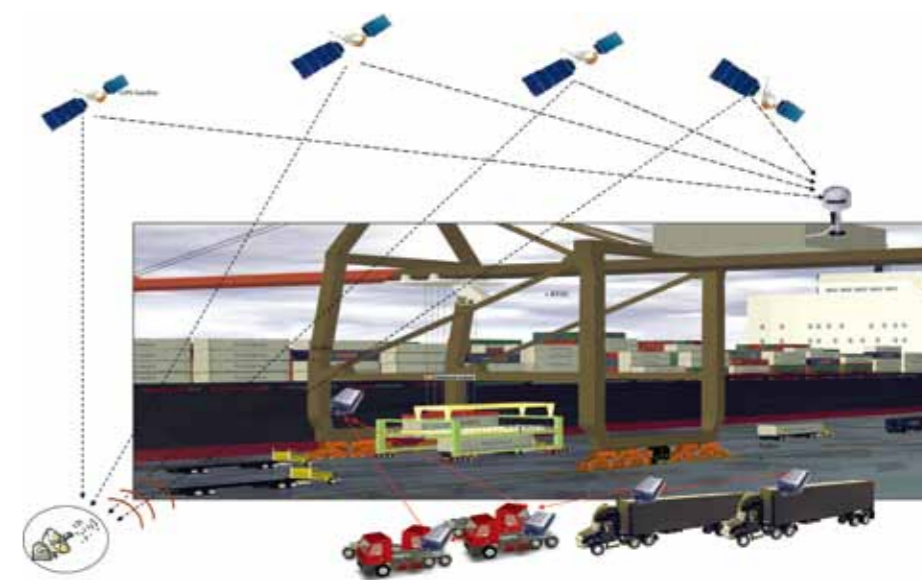

Employing wireless sensor technology and a differential global positioning system, the system enables workers to make just-in-time decisions on the movement of rubber-tired gantry cranes and on truck allocation in a container terminal. It also collects real-time data such as the positions of trucks and the queue lengths under quay cranes to support the terminal operations accurately. Containers can then be loaded or discharged with a shorter lead time, thus saving manpower for monitoring and tracking.

This innovative system won a Bronze Medal at the 38th International Exhibition of Inventions of Geneva.

Overview of the system operation
系統運作概覽

由管理及市場學系倪偉定教授與物流及航運學系團隊開發的集裝箱碼頭智慧運作決策支援系統，能夠以低成本監測集裝箱碼頭設備和卡車的實時狀態與位置。

該發明引入無線感應技術和特定全球定位系統，方便工作人員作出最適時的碼頭運作決策，如輪胎式門型起重機移動指令，以及卡車位置指示。這系統能整合多種實時數據，包括卡車位置及碼頭起重機前的排隊狀態，使碼頭的操作程式更加精準，而集裝箱的裝卸時間亦可縮短，從而減少監測和追蹤集裝箱所需的人手。

這套智能系統在第三十八屆日內瓦國際發明展中奪得銅獎。❖

From left: Dr Lai Kee-hung, Prof. Eric Ngai, Prof. Li Chung-lun, Prof. Edwin Cheng and Dr Venus Lun
左起：黎基雄博士、倪偉定教授、李仲麟教授、鄭大昭教授及倫婉霞博士

TCM diagnostic systems help detect health problems
中醫診斷系統協助偵察身體毛病

Prof. David Zhang, Chair Professor of the Department of Computing, has been leading the Biometrics Research Centre to develop three authentication and medical diagnostic tools based on the traditional Chinese medicine (TCM) principles of inspection, auscultation and olfaction, and palpation (望聞切).

The three new inventions are:

(1) The Automated Tongue Image Acquisition and Analysis System, which can capture the image and features of a tongue and detect a change in the tongue colour that may indicate early symptoms of some health problems;

(2) The Pulse Wave Analysis System, which can plot the signal of a patient's pulse on a graph for pulse pattern categorization to determine his/her basic health status and diagnose some common health problems; and

(3) The Medical Biometrics Olfaction Analysis System, which can decompose a patient's exhaled gas for further analysis using electronic olfactory technology. The system can also distinguish healthy people from patients, monitor the medical treatment of diseases and measure blood glucose levels.

With these innovative tools, patients' health status can be measured and compared against the massive Chinese Medical Biometrics Database formed by collecting data from over 30,000 patients in northern China in the past 10 years for accurate diagnosis. Looking ahead, Prof. Zhang will expand the database by gathering information from patients in southern China.

理大人體生物特徵識別研究中心在電子計算學系講座教授張大鵬教授帶領下，根據傳統中醫診斷「望聞切」的原則，開發了三套中醫認證和醫療診斷工具。

這三項創新發明包括：

(1)「電腦舌像採集與分析系統」—透過採集舌頭圖像及特徵，某些疾病的早期症狀，可以從舌體顏色的變化體現出來；

(2)「脈象波形採集與分析系統」—將病者的脈搏信號繪製在曲線圖上，以脈搏模式進行分類，分析病者的基本身體狀況及診斷一些常見的疾病；

(3)「人體呼氣採集與分析系統」—分解病者呼氣成分和利用電子嗅覺技術作進一步分析，系統更可區分病者和健康人士、監控治病的療程，以及測量血糖水準。

這些嶄新工具有助評估病人的健康狀況，以便與中醫生物特徵識別數據庫內於過去十年在華北地區三萬多名病者中蒐集到的大量數據作比較，從而進行準確的診斷。展望未來，張教授將收集華南地區病者的相關資料，以擴展數據庫。❈

1. Prof. David Zhang explains the newly developed medical diagnostic tools
   張大鵬教授講解新開發的醫療診斷工具

2. The Automated Tongue Image Acquisition and Analysis System in demonstration
   示範使用「電腦舌像採集與分析系統」

3. Plotting pulse signal by the Pulse Wave Analysis System
   「脈象波形採集與分析系統」正繪製脈搏信號圖

4. The Medical Biometrics Olfaction Analysis System in demonstration
   示範使用「人體呼氣採集與分析系統」

Evaluating dust control practices for the benefits of construction workers
評估塵埃控制措施　造福建築業人士

Research team: (from left) Dr Lu Wei-sheng, Dr Fan Shi-chao, Prof. Wang Tao, Prof. Geoffrey Shen Qi-ping, Dr Ann Yu, Prof. Shen Li-yin and Dr Wong Yuen-wah
研究團隊：（左起）呂偉生博士、范士超博士、王韜教授、沈岐平教授、余峽芸博士、申立銀教授及黃元華博士

Prof. Geoffrey Shen Qiping, Chair Professor of Construction Management and Head of the Department of Building and Real Estate, and his team are conducting a comprehensive study to evaluate the effectiveness of the current dust control practices in Hong Kong's construction industry. Construction dust, particularly silica dust, is harmful to human health. The over-exposure of construction workers to respirable crystalline silica, even for a short period, can lead to silicosis.

Funded by the Pneumoconiosis Compensation Fund Board, this research project is being conducted by collecting both full-shift and process-specific workers' respirable dust samples from local construction sites and analysing them using X-ray diffraction based on the National Institute of Occupational Safety and Health standards of the USA. Full-shift measurement collects personal respirable samples during a full workday, whereas process-specific measurement samples the air breathed while workers are carrying out construction processes such as drilling, grinding and cutting.

Based on analysis of the net weight of respirable particulates and the levels of crystalline silica dust, the effectiveness of local dust control practices will be evaluated and areas of improvement suggested.

建築及房地產學系建設管理講座教授兼系主任沈岐平教授與團隊正進行一項綜合研究，評估香港建造業推行灰塵控制措施的效益。建築塵埃對人體有害，尤以二氧化矽塵埃為甚。建築工人過度暴露於經呼吸進入人體的結晶型遊離二氧化矽，即使是很短的時間，都可引致矽肺病。

該研究項目獲得肺塵埃沉著病補償基金委員會資助，在建築工地收集全更工作及特定工序工人經呼吸進入人體的塵埃樣本，然後根據美國國家職業安全與健康研究所的標準用X射線衍射儀來分析。全更工作工人的樣本用來測量他們在整個工作天中所吸入的塵埃，而特定工序工人的樣本則測量他們在進行鑽孔、研磨及切割等建築程式中所吸入的塵埃。

研究會根據可吸入人體的微粒狀物質的淨重量、以及結晶型遊離二氧化矽塵埃水準進行分析，然後利用分析的結論來評估本地塵埃控制措施的效益，該團隊亦會就改良方案作出建議。❈

Sampling during grinding process
在研磨工序中收集吸入人體的塵埃樣本

Engineering and Technology 工程學與科技

New technology optimizes the quality of digital images
嶄新技術優化數碼影像

Supported by the HKSAR Innovation and Technology Fund, a research team led by Dr Zhang Lei, Assistant Professor of the Department of Computing, has developed a Digital Video Signals Optimization System, thereby enhancing the quality of digital images and videos in consumer electronics.
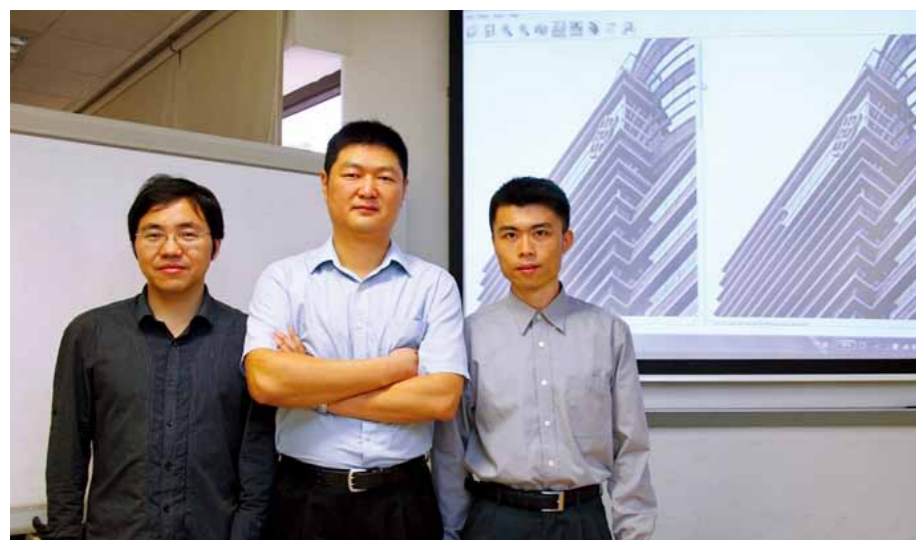
Dr Zhang Lei (middle) and his research team members
*張磊博士(中) 與研究小組成員*

The system can process short films shot using home video cameras and mobile phones as well as traditional movies, thus improving the quality of an image from the raw video stage and removing noise and blurs. Using its super resolution technology, the system can also repair static digital images by reconstructing blurs, sharpening the fineness of the image profile and improving the overall quality of images.

Experimental results have proved that the new system is superior to those currently in use both in terms of subjective visual sense and objective measurement of the peak signal to noise ratio. Its distinct functions include: (1) removing noise from full-colour videos; (2) removing noise from raw colour filter array (CFA) videos shot with single charge-coupled device cameras; (3) restoring full colour videos from raw CFA videos; and (4) super resolution technology to optimize video resolution from standard to high.

在香港特區政府創新及科技基金的資助下，電子計算學系助理教授張磊博士領導一個研究小組研發出「數碼影像優化系統」，使消費類電子產品數碼圖像和影像的質素得以大大提升。

一般家用數碼攝像機或流動電話拍攝的短片、甚至舊制式菲林電影，一經該系統處理，就可以提升原始影像的質素，並消除雜訊和模糊影像。利用超解像技術，新系統亦可復修圖像，將模糊不清的影像重新建構，加深輪廓的細緻程度，以及改善圖像的整體質素。
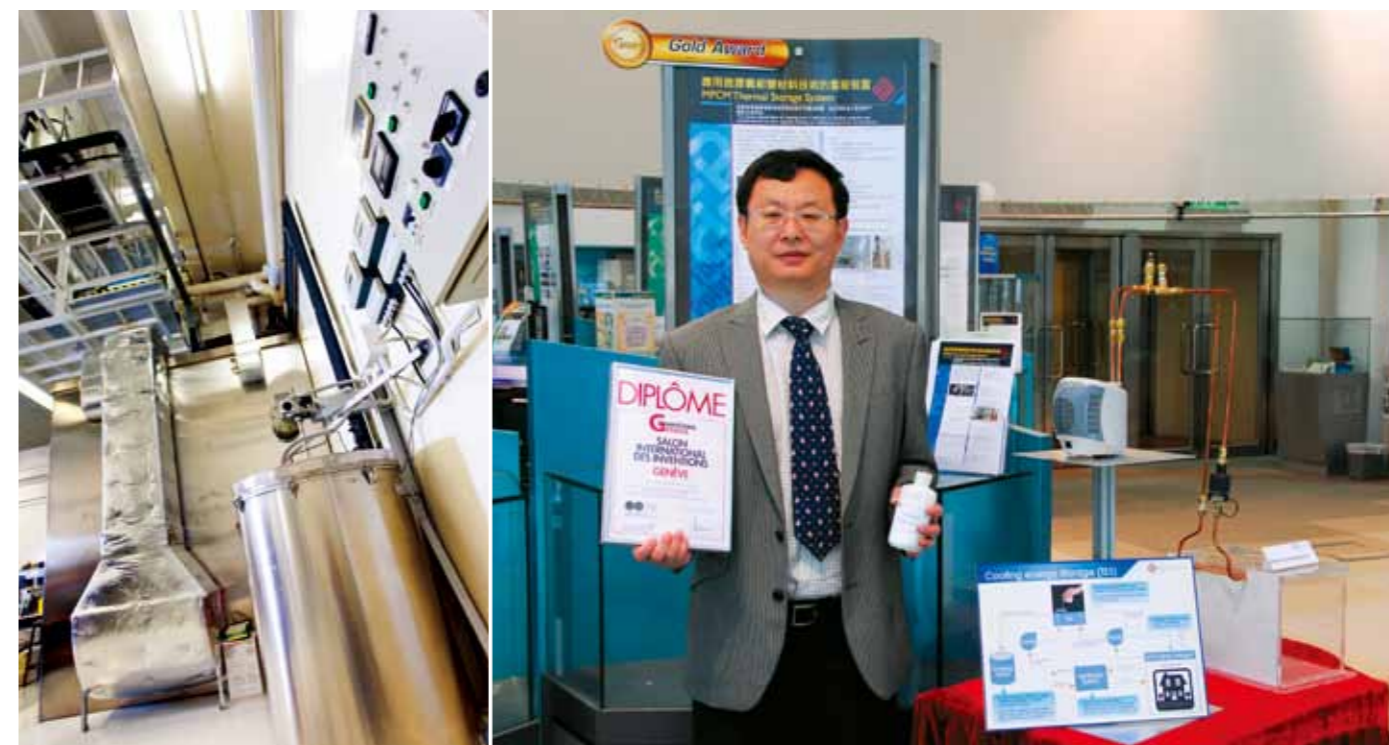
實驗結果顯示　，無論在主觀的視覺官感方面，還是在客觀的「尖峰訊號雜訊比」方面，新技術都較現有的技術優勝。新系統的功能包括：(1)消除全彩色影像雜訊；(2)消除用單一電荷耦合器攝影機拍攝的原始影像雜訊；(3)還原原始影像的三原色；(4) 以超解像度技術優化標清影像，提升其解像度至高清影像。
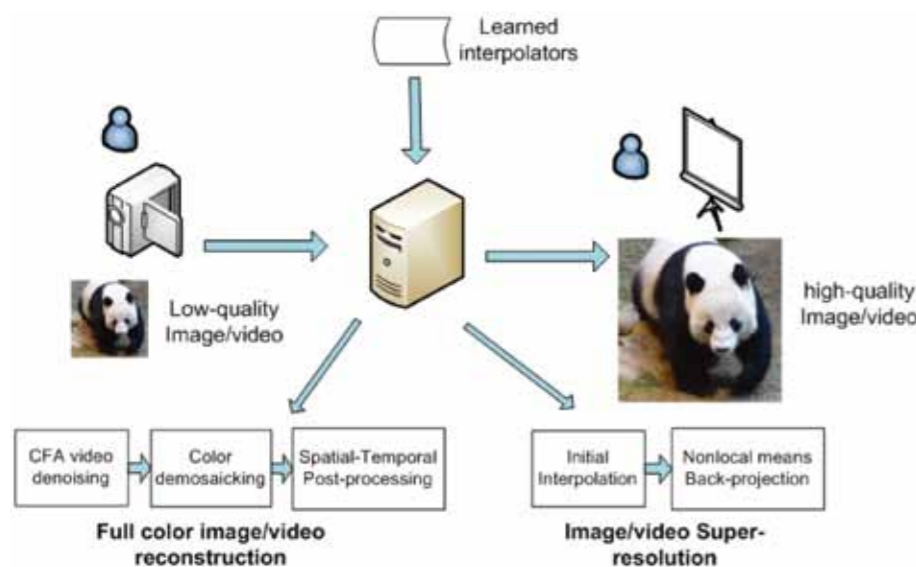
System diagram
系統運作圖

Eco-friendly thermal storage system enhances energy efficiency
環保蓄能裝置　提供能源效益

The novel thermal storage system
嶄新的蓄能裝置

Prof. Niu Jianlei
牛建磊教授

Prof. Niu Jianlei of the Department of Building Services Engineering has invented the Micro-Encapsulated Phase Change Material Thermal Storage System, with the use of new thermal energy storage material replacing water or ice-slurry. The system has greatly improved the performance of modern thermal storage systems and thus achieved higher level of energy efficiency.

When mixing the nanotechnology-based micro-encapsulated phase change material with water, milky slurry is formed, which can function as thermal energy storage and heat transfer working fluid to replace the plain water or ice-slurry now commonly used in building cooling systems, thereby lower their energy consumption remarkably.

Winning a Gold Medal with Jury's Commendation at the 38th International Exhibition of Inventions of Geneva, this invention is the fruit of interdisciplinary research collaboration amongst PolyU's Department of Building Services Engineering and Institute of Textiles and Clothing, Tsinghua University, and Delft University of Technology in the Netherlands. The research was supported by the HKSAR government's Innovation and Technology Fund and a Competitive Earmarked Research Grant from the Research Grants Council.

屋宇設備工程學系牛建磊教授利用新型相變蓄熱材料，取代水或冰溶液，研發了一套「應用微膠囊相變材料技術」的蓄能裝置，大大改善現代蓄能系統的效能，從而提高能源效益。

研究人員以納米技術為基礎，製成「微膠囊相變材料漿液」。該材料與水混合後，形成狀似牛奶的漿液，可用作儲存熱能及傳熱流體，取代現時常用於建築空調系統中的清水及冰漿，顯著減低系統耗電量。

這項突破性發明在第三十八屆日內瓦國際發明展中奪得評審團特別嘉許金獎。有關研究由理大屋宇設備工程學系、紡織及製衣學系、清華大學及荷蘭代爾福特大學一起進行，是一項跨領域合作研究，並獲香港特區政府創新及科技基金和研究資助局研究用途補助金的支持。

Engineering and Technology　工程學與科技

Apparel development made easy with EPAS
樣辦遙測系統簡化服裝設計過程

Dr Roger Ng Keng-po of the Institute of Textiles and Clothing, and Mr Brian Lee Yu-hin and Dr Eva Yuen of the School of Design, have jointly invented an E-Clustered Prototype Assessment System (EPAS). The system enables fashion designers and merchandisers to mix and match materials remotely for the development of new apparel, simplifying the decision-making process without the need for long-distance travel.

Using EPAS, fashion designers and merchandisers can jointly examine and discuss the application of material samples in widespread geographical locations. The system not only supports physical sample examination with its high-fidelity video stream and images showing the delicacy of fabric with accurate colour spectrum and level of brightness, but also displays live fitting from different perspectives simultaneously.

This breakthrough won a Silver Medal at the 38th International Exhibition of Inventions of Geneva.

紡織及製衣學系吳鏡波博士、設計學院李宇軒先生及阮曼華博士聯合開發了一套「e-群體樣辦遙測系統」，讓時裝設計師和採購員可以遙距地混合搭配不同的衣料，以開發新的服裝產品。這系統簡化了時裝設計師和採購員的決策過程，他們毋須長途跋涉，便可即時作出決定。

這系統可讓分佈於不同地方的時裝設計師和採購員，同時遙距測試及討論實物樣辦的應用。系統既可方便檢視實物樣辦，亦透過其高傳真串流視像及影像，可以清楚顯示布料的細緻組織、顏色層次和光澤深淺，更可從多角度顯示試身的情況。

這嶄新系統在第三十八屆日內瓦國際發明展中奪得銀獎。❈

E-Clustered Prototype Assessment System
e-群體樣辦遙測系統

Dr Roger Ng Keng-po (right) and Mr Brian Lee Yu-hin
吳鏡波博士(右)及李宇軒先生