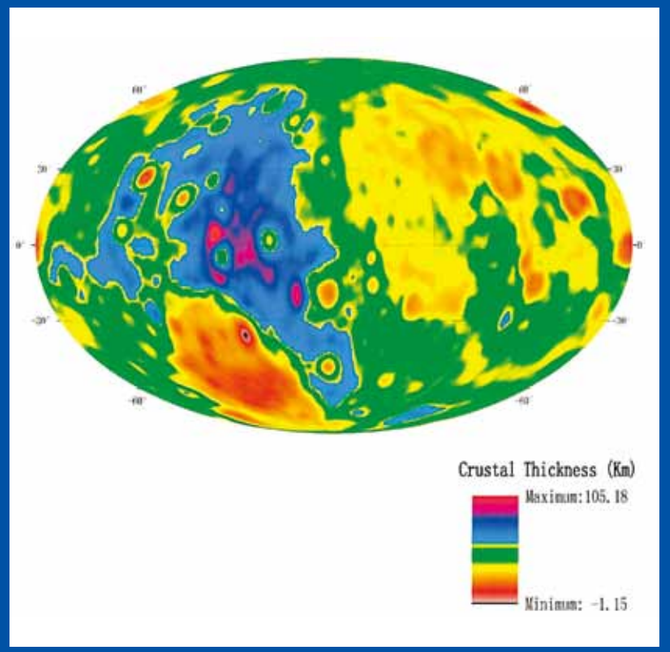
Technology 科技

Making strides in lunar mapping
月球測圖研究獲重大進展

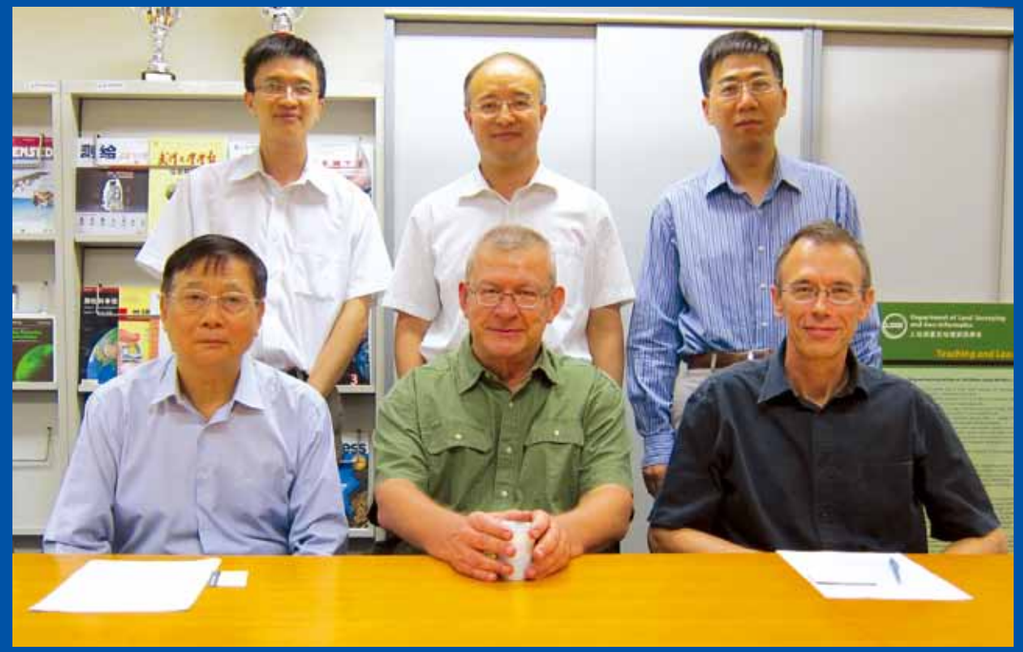


Researchers calculate the crustal thickness of the Moon using the advanced three-dimensional imaging technology.
研究人員以先進的三維圖像技術計算月球地殼的厚度。

PolyU surveying experts pioneer advanced methodologies for precise Moon mapping.

理大測量專家率先利用先進技術，開發月球精密測圖方法。

The research team - (front row from left) Prof. Chen Yong-qi, Prof. Baki Iz and Dr Bruce King; (back row from left) Dr Wu Bo, Prof. Ding Xiao-li and Prof. Chen Wu
研究團隊 - (前排左起) 陳永奇教授、Baki Iz 教授及Bruce King博士；(後排左起) 吳波博士、丁曉利教授及陳武教授



Led by Prof. Chen Yong-qi, Emeritus Professor at the Department of Land Surveying and Geo-Informatics, PolyU surveying experts Profs. Chen Wu, Ding Xiao-li, and Baki Iz, and Drs Bruce King and Wu Bo have successfully developed methodologies for precise mapping of the Moon.

PolyU's lunar mapping project began in 2006. Serving on the Expert Committee of China's Lunar Exploration Programme, Prof. Chen Yong-qi analysed the data captured by the Chinese lunar orbiter, Chang'e-1, and other lunar exploration missions. In doing so, he and his research team pioneered a unique and innovative approach to create accurate three-dimensional models of the lunar surface by integrating Chang'e-1 digital imagery and laser altimeter data. In collaboration with research centres on the Chinese mainland and overseas, the team evaluated the digital elevation model (DEM) of the Moon derived from the Chang'e-1 laser altimeter data against previous data from the Japanese Selene and US Clementine missions.

The researchers also produced the most up-to-date parameters of the lunar figure (the shape of the moon) using 17.5 million laser altimetry measurements from the Chang'e-1 and the Japanese Selene missions. They used the new topographic and gravity models to update the Moon's calculated crustal thickness and mass distribution, finding that the crust averages a thickness of approximately 40 km on the near side and 50 km on the far side of the Earth.

Chinese space expert and PolyU honorary graduate Prof. Luan Enjie (right) exchanges views with Prof. Chen Yong-qi while visiting PolyU.
中國航天專家兼理大榮譽博士欒恩傑教授(右)訪問理大時與陳永奇教授交流。

一個由理大測量及地理資訊學系榮休教授陳永奇教授領導的測量專家團隊，包括陳武教授、丁曉利教授、Baki Iz教授、Bruce King博士和吳波博士，成功研發出月球精密測圖的方法。

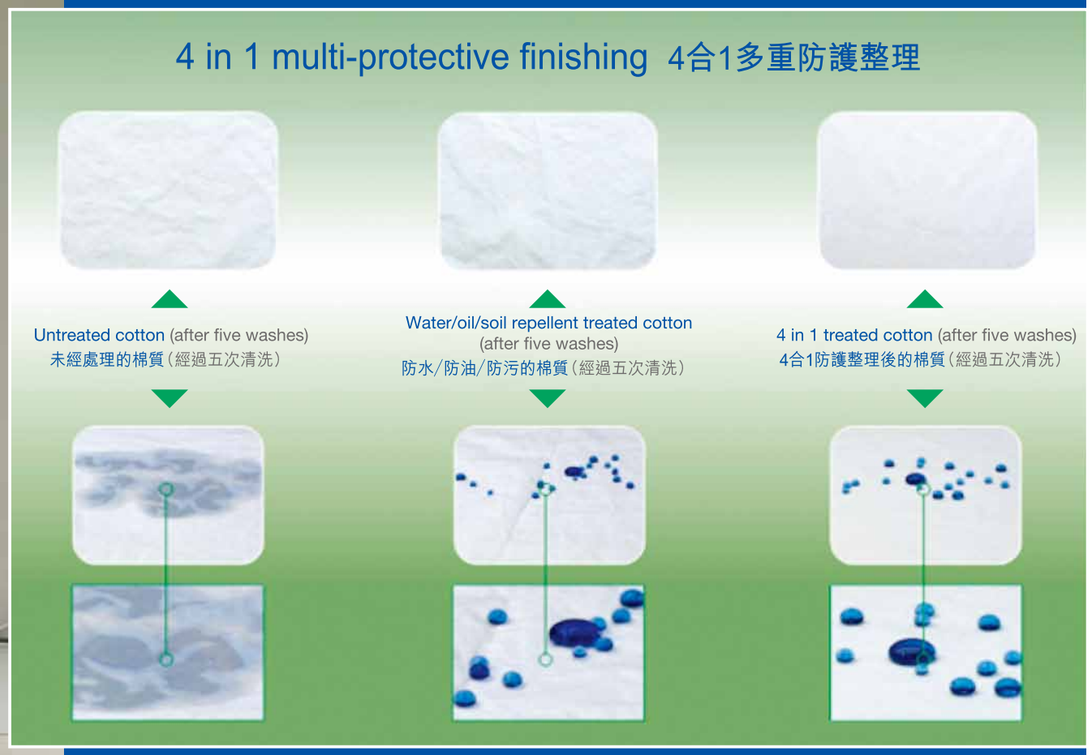
理大的月球測圖工程始於二零零六年。陳永奇教授是中國繞月探測工程科學應用專家委員會委員，致力研究分析中國「嫦娥一號」人造月球衛星及其它探月任務所獲取的資料。理大團隊率先以獨特和創新的方法，將「嫦娥一號」的數位圖像與鐳射測高儀的資料結合，開發精確繪製月球表面三維立體模型圖的技術。團隊更與中國內地和海外的科研中心合作，把「嫦娥一號」鐳射測高儀資料跟以往日本「月亮女神」和美國「克萊門汀」所得的探月資料作比較，評估由它們衍生出月球數位高程模型的質量。

此外，理大科研人員利用「嫦娥一號」和日本「月亮女神」採集的一千七百五十萬個鐳射測高點的數據，計算出月球形狀和大小的最新參數。他們更以全新的地形和引力模型計算出最新的月球地殼厚度和質量分佈，從而確定靠近地球的一邊，月球地殼的平均厚度大約為四十公里， 而較遠的一邊則為五十公里。

Technology 科技

Ground-breaking textile material enhances functionality of sportswear
嶄新紡織物料提升運動服功能

Prof. John Xin (right) and Miss Kong Yee-yee display the light control intelligent textile material.
忻浩忠教授（右）與江怡怡小姐展示光控智能紡織材料。



Textile scientists create a new kind of fabric that absorbs water and perspiration on one side and transports it to the other.

紡織科學家研發出一種嶄新紡織材料，它可以在一面吸收水分和汗液，然後將水分傳輸到布料的另一面。

Prof. John Xin, Acting Head of PolyU's Institute of Textiles and Clothing, PhD student Miss Kong Yee-yee and Dr Liu Yuyang of the Stevens Institute of Technology in the US have jointly created a new kind of fabric that can absorb water and perspiration on one side and transport it to the other. Their research findings were published in the *Journal of Materials Chemistry* (13 October 2011 issue) of the Royal Society of Chemistry.

By coating the fabric on one side with nano titania, the researchers gave the material photo-induced hydrophilicity. That property can be controlled by light, with the fabric becoming hydrophobic in the dark. The fabric can be used to wick sweat away from the wearer's skin. Under light, water is transported in a controllable manner from the hydrophobic side (next to the skin) to the hydrophilic side, and then spreads out rapidly along the channels on the hydrophilic side.

This differs from what occurs in similar materials, which work by using pressure difference to create a surface energy gradient across the fabric. Prof. Xin's discovery introduces nano and smart elements to the system, taking advantage of titania's properties.

Before creating this novel material for use in sportswear, Prof. Xin invented the "4 in 1 multi-care finishing technology", which can achieve water, oil and soil repellency and the wrinkle-free treatment of textiles in one step. This groundbreaking technology introduces "elastic cross-linking" to the award-winning Lotus Nano® repellent system, which not only offers wrinkle-recovery function for textiles but also minimizes strength loss. Moreover, cross-linking can remarkably improve the wash fastness of Lotus Nano® repellent functions to achieve excellent and durable multifunctional properties.

紡織及製衣學系署理系主任忻浩忠教授、博士研究生江怡怡小姐、以及美國史蒂文斯科技學院劉玉陽博士共同研發出一種嶄新紡織材料，它可以一面吸收水分和汗液，然後再將水分傳輸到布料的另一面。研究成果已刊載於英國皇家化學學會出版的《材料化學期刊》（二零一一年十月十三日號）。

研究人員透過在布料的一面塗上氧化鈦納米物料，使布料在感光後具有親水性，而它的親水性能可以由光控制，布料在黑暗處卻會變得不易被水沾濕。這種布料可以用來吸附人體皮膚上的汗水。在光線下，水分以可控的方式從貼近人體皮膚的疏水一邊輸送到親水性的一邊，然後沿著親水面上的通道迅速擴散和揮發。

這種布料有別於其他具有類似功能的布料，現有的材料沿布料創建一個表面能量梯度，然後利用形成的壓差發揮作用。

忻浩忠教授則在開發的過程中，充分利用氧化鈦的特性，在傳輸系統中結合了納米技術與智能物料的元素。

在研發這可供製造運動服的嶄新物料之前，忻浩忠教授亦發明了「4合1多重防護整理技術」，即一個步驟實現織物防水、防油、防污及防皺的整理技術，簡稱四防整理。這突破性技術是在獲獎的「荷葉納米三防體系」中引入「彈性交聯」的作用。「彈性交聯」不僅能使織物的皺紋自動回復，同時將強力損傷降至最低。另外，交聯作用亦能顯著提高織物中「荷葉納米防護功能」的水洗牢度，因而賦予織物持久卓越的多重防護功能。

Life Sciences 生命科學

Improving food safety with cutting edge technology research
尖端科研提升食物安全

The Research Centre was officially opened by guests including Mr Liu Sheng Li, Director General of Shenzhen Entry-Exit Inspection and Quarantine Bureau (fourth from left); Mr Clement Leung, Director of Food and Environmental Hygiene, HKSAR Food and Environmental Hygiene Department (fifth from left); Prof. Timothy W. Tong, President of PolyU (fifth from right); and Mr Huang Wei Ming, Deputy Director General of Guangdong Entry-Exit Inspection and Quarantine Bureau (fourth from right).
深圳出入境檢驗檢疫局局長劉勝利先生（左四）、香港特區政府食物環境衞生署署長梁卓文先生（左五）、理大校長唐偉章教授（右五）及廣東出入境檢驗檢疫局副局長黃偉明先生（右四）等嘉賓聯袂主持中心的開幕禮。

On 9 August 2011, PolyU's Department of Applied Biology and Chemical Technology (ABCT) officially opened its Food Safety and Technology Research Centre, the first of its kind run by a higher education institution. Headed by Prof. Wong Wing-tak, Director of the Centre and ABCT Head, the Centre's mission is to raise food safety standards through food science research, new technology development, and consultancy and training for food and related industries in Hong Kong and the Pearl River Delta Region.

Bringing together expertise from biochemistry, biophysics, microbiology, toxicology and nutrition, the Centre will not only help to raise food safety standards and the related testing and certification, but also facilitate interdisciplinary collaboration in the region.

"In the long run, we hope to bolster public confidence in the safety of food supplies", said Prof. Wong.

Researchers at the Centre emphasize the development of rapid, high-throughput and accurate technology to detect harmful substances in foods, such as toxins, contaminants, antibiotics and food-borne pathogens. In April this year, a portable DNA biosensor developed by the Centre received a Gold medal at the 39th International Exhibition of Inventions of Geneva.

PolyU establishes Food Safety and Technology Research Centre to advance food safety standards in the region.

理大設立食物安全及科技研究中心，以提升地區的食物安全水平。

The Centre is equipped with sophisticated instruments, including the Nuclear Magnetic Resonance System and the Chromatography and Spectrometer System for the highly specialized testing of chemical composition, contaminants, marine toxins, trace elements and heavy metals at a molecular level. These devices offer greater speed, accuracy, specificity and sensitivity than conventional laboratory testing.

The Centre also focuses on exploring the effects of bacterial and chemical contamination on the health of the Asian population, and Chinese in particular, given their unique diet and lifestyle. The research results will provide conclusive scientific evidence for advancing food safety standards.

In addition, the Centre offers expertise and technology in support of the food industry. One example is the provision of advanced sensory evaluation facilities for taste-testing new food products under strict conditions, which is an essential process for boosting flavour and quality in food product development. Expertise in food processing is also available to help local food businesses in setting up rigorous procedures to meet global safety standards.

Another of the Centre's missions is to develop unique formulae for producing functional food, such as mushrooms, tea and soybeans, that has the potential to fight chronic diseases and improve health beyond providing nutrients.

二零一一年八月九日，理大應用生物及化學科技學系成立首間由高等學府營運的食物安全及科技研究中心。應用生物及化學科技學系系主任兼食物安全及科技研究中心總監黃永德教授將領導中心，以提升食物安全水平為使命，推動食品科學研究，研發新技術，並為香港及珠三角地區的食品及相關行業提供顧問及培訓服務。

Gas Chromatography System
氣相色譜分析系統

Nuclear Magnetic Resonance System
核磁共振系統

該中心集合生物化學、生物物理學、微生物學、毒理學和營養學的專家，不但有助提升食物安全及相關的檢測與認證工作的水平，同時促進區內跨學科的合作。

黃教授表示：「長遠來說，我們期望加強公眾對食品安全的信心。」

中心的研究人員銳意開發快速、高效及準確的技術，以檢測食品中的有害物質，例如：毒素、污染物、抗生素及食源性致病菌等。今年四月，該中心研發的一部便攜式基因即時感測器更於日內瓦舉行的第三十九屆國際發明展中獲得金獎。

該中心配置了最先進的儀器，包括核磁共振系統和可準確檢測食品的化學成份、污染物、海洋毒素、微量元素，以及達分子水平之重金屬的氣相色譜分析系統。與傳統實驗室的化驗相比，這些儀器可助達致更快捷、準確、專門和仔細的檢測效果。

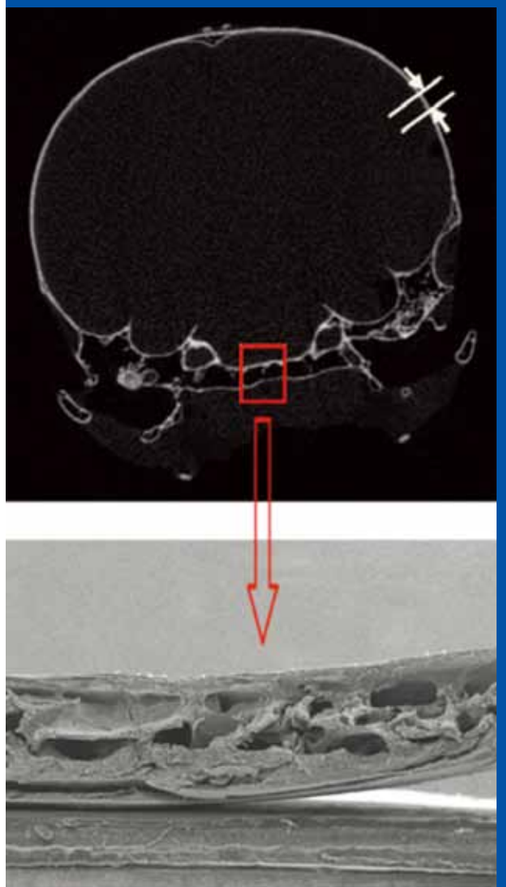
中心重點研究細菌和化學污染對亞洲人口健康的影響，尤其是有獨特飲食習慣及生活方式的中國人。研究結果將會為提高食物安全標準提供確實的科學數據。

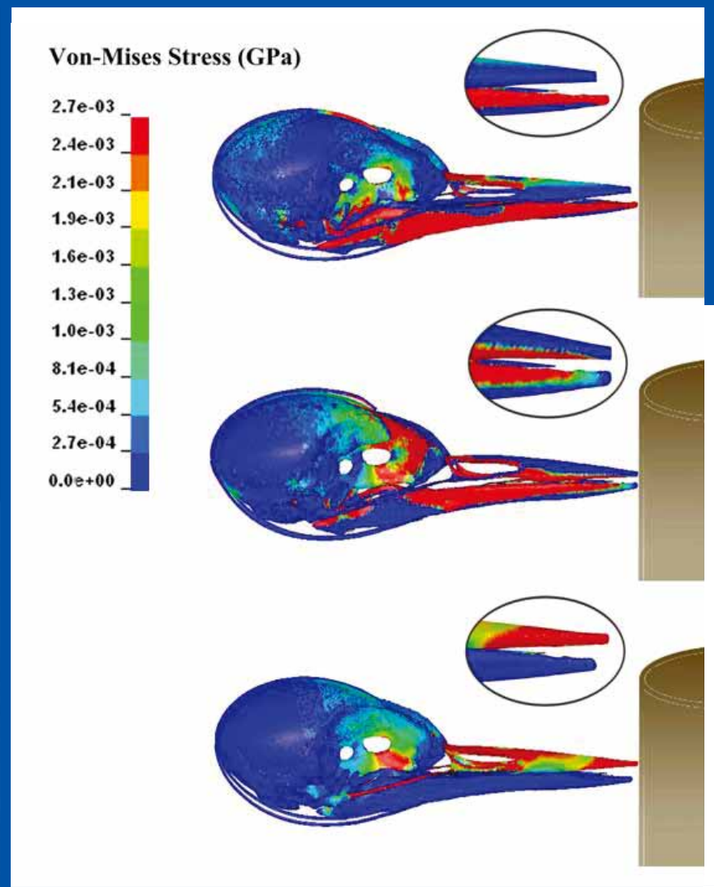
此外，研究中心為食品業提供專業及技術支援，例如：設置先進的味道分析儀器，在嚴格的條件下測試新食品的味道，有助業界在研發過程中提升食品的味道和質素。中心的食品製造程序專家，更協助本地食品業建立嚴謹的程序，以符合國際安全標準。

該中心另一使命是開發獨特的配方以製造功能食品，例如：冬菇、茶類及豆類等，發揮其本身營養價值之外，更具備對抗慢性疾病和強身健體的功能。

Life Sciences 生命科學

Woodpecker study unlocks the key to avoiding head injury
啄木鳥研究提供避免頭部受傷之關鍵





The "spongy" bone structure at different points in the woodpecker's skull helps to distribute the incoming force, thereby protecting the brain.
啄木鳥顱骨有海綿狀的骨骼結構緩衝了衝擊力，腦部因而受到保護 。

Researchers develop computation models to show the stress distribution of woodpeckers' beaks with different lengths of the upper and lower halves.
研究人員建立電腦模型，分析上下兩半長度不同的啄木鳥嘴被撞擊時的重力分佈。

Research on why woodpeckers' pecking does not cause head injury is expected to provide insights on the design of human protective devices.

為什麼啄木鳥的啄食動作不會令其頭部受傷？有關研究的結果將有助改良人類保護裝置的設計。

A pioneering study, jointly led by Prof. Zhang Ming of PolyU's Department of Health Technology and Informatics and Prof. Fan Yubo of Beihang University, has unravelled the mystery of why the repeated tree-pecking motion of woodpeckers does not cause brain injury.

The researchers conducted a series of experimental studies and a computer simulation. Two synchronous high-speed video systems were used to observe the pecking motion of woodpeckers and a force sensor was used to measure the pecking force. The mechanical properties and macro/micro morphological structure in the woodpecker's head were investigated using a mechanical testing system and micro-CT scanning. Computational models of the woodpecker's head were established to study the dynamic intracranial responses.

The research findings show that a combination of three factors protects the woodpeckers from injury. First, the woodpeckers' skulls are protected by the hyoid bone's looping structures, which act like a "safety belt". Second, the upper and lower halves of the birds' beaks are uneven in length, and this asymmetry reduces the impact of the pecking force transmitted from the tip of the beak to the brain. Third, the "spongy" bone structure at different points in the skull helps to distribute the incoming force, thereby protecting the brain.

The researchers anticipate that more quantitative studies will be needed before this bio-mechanism can be applied to the design of human protective devices, such as helmets and other related products.

理大醫療科技及資訊學系張明教授和北京航空航天大學樊瑜波教授共同帶領一項創新研究，破解為何啄木鳥重複在樹木上啄食的動作不會令其頭部受傷。

研究人員進行了連串的實驗和電腦模擬分析，他們採用兩台同步高速攝像機捕捉啄木鳥的頭部動作，並利用重力感應器測量啄食動作的推撞力。他們更採用機械測試系統與微型電腦掃瞄分析啄木鳥頭部的機械特性與宏觀及微觀結構，從而建立啄木鳥頭部與撞擊反應的電腦分析模型。

研究結果顯示，啄木鳥的啄食動作不會對其頭部產生任何傷害，是基於三個共同發揮作用的綜合因素。首先，啄木鳥的頭蓋骨上有一層舌骨的迴圈結構，它如同安全帶般起着保護作用。其二，啄木鳥的嘴部上下兩半長度不同，這不對稱結構降低了由嘴尖傳輸至大腦的衝擊力量。其三，啄木鳥頭蓋骨中不同點的「海綿狀」骨骼結構緩衝了衝擊力，因此腦部受到保護。

研究人員預期必須進行更多以數據為基礎的研究，才可把該生物機制應用於人類保護裝置及其他工業設計上，例如頭盔和其他相關產品。

Design 設計

The Musketeers Education and Culture Charitable Foundation, PolyU, the Hong Kong Design Centre and the Hong Kong Design Institute join hands to transform the former Police Married Quarters into a creative industries landmark.

同心教育文化慈善基金會、理大、香港設計中心及香港知專設計學院攜手改造前已婚警察宿舍成為創意產業地標。

Building a creative industries landmark
打造創意產業新地標

In view that Hong Kong is in need of a new landmark for further development of design and creative industries, the HKSAR government invited proposal in 2010 for transforming the former Police Married Quarters (PMQ) on Hollywood Road into a creative industries landmark. Soon after, the Musketeers Foundation, PolyU, the Hong Kong Design Centre and the Hong Kong Design Institute formed a consortium and submitted a proposal, which was subsequently accepted by the government.

With an area of about 0.6 hectares, PMQ is located in the heart of Soho in Central District and forms part of the Dr Sun Yat-sen Historical Trail. It lies at the centre of a design and creative industries cluster, with a number of high quality design studios and art galleries, dining and shopping facilities nearby. The redeveloped PMQ will have a mission to gather the currently geographically dispersed creative industries in different scales to facilitate the exchange of ideas and access to information and opportunities on international design and market trends.

香港特區政府為了進一步推動設計創意產業的發展，於二零一零年邀請企業提交建議書，將荷李活道前已婚警察宿舍(PMQ)改造成為標誌性的創意中心。不久，同心教育文化慈善基金會、理大、香港設計中心及香港知專設計學院組成聯盟，並提交建議，建議最終亦被政府接納。

PMQ的面積約0.6公頃，位處中環蘇豪區的心臟地帶，是孫中山史蹟徑的一部分。PMQ位於設計和創意產業聯網之中，毗鄰優質的設計工作室和畫廊、餐廳和購物設施。改造後的PMQ肩負重要使命：匯聚目前分散各處、不同規模的創意產業進行交流，分享環球設計和市場趨勢的訊息及契機。

Conceptual design of the creative industries landmark
創意產業地標的設計概念

Design 設計

PolyU Vice President (Academic Development) Prof. Walter W. Yuen said, “PolyU is proud to be a key partner of the PMQ revitalization project, showing our University’s expertise and contribution to Hong Kong in the areas of Sustainable Development, Innovation and Entrepreneurship, as well as Advanced Executive Education. The PMQ project shall further strengthen our teaching and research, specifically in design and fashion related studies.”

Scheduled for opening in the first quarter of 2014, PMQ will provide almost 20,000 square metres of floor space, expected to house over 130 top and young emerging designer brands and for small and medium enterprises to set up affordable studio shops. There will be a Creative Resources Centre where designers can network with local manufacturers, exporters and buyers. It will also be an alternative shopping complex with restaurants for locals and tourists to enjoy the unique ambience of design excellence.

Mr Alvin Yip, Leader of RICE Lab (Research in Competition and Exhibition Laboratory) of PolyU’s School of Design, said, “PMQ will facilitate the development of Hong Kong original brands and creative talents, thus assisting the creative industry to establish and expand to mainland and overseas markets and sustain Hong Kong’s role as a leading creative hub in Asia.”

Capitalizing on PolyU’s strength in professional design education and international partnership, a number of seminars, workshops, exhibitions and themed events will be organized by PMQ throughout the year. A design enterprise support programme and a designers-in-residence programme will also be lined up.

PMQ will be run as a social enterprise and will bring social values of design to the community. Any profit obtained from the operation will be reinvested in the community for the benefit of the creative industries.

理大副校長（學術發展）阮偉華教授表示：「理大很榮幸成為改造PMQ項目的一個主要合作夥伴，顯示大學在可持續發展、創新及企業家精神，以及高級行政教育等領域有一定的專長，而且對香港有相當貢獻。PMQ項目將有助進一步加強我們的教學和研究，特別是在設計和與時尚相關的研究上。」

PMQ預計於二零一四年第一季開幕，它將提供近二萬平方米的建築面積，可容納超過一百三十個傑出及新興設計師品牌，並讓中小型企業成立可負擔得起的工作室店舖。同時，PMQ將設置一個創意資源中心，讓設計師與本土生產商、出口商和採購商聯繫。此外，它亦是一個設有餐廳的另類購物中心，供本地人和遊客享受卓越設計的獨特氛圍。

理大設計學院競賽及展示研究室主任葉長安先生表示：「PMQ將有助香港品牌的發展和創新人才的培訓，從而幫助創意產業拓展內地及海外市場，保持香港作為亞洲領先創意中心的地位。」

憑藉理大在專業設計教育及與國際合作方面的優勢，PMQ將每年舉辦講座、工作坊、展覽和主題活動。此外，PMQ亦會展開設計企業支援計劃及駐場設計師計劃。

PMQ將以社會企業模式營運，利用設計創造社會價值。其營運中所得的盈利，將再投放於社區，以造福創意產業。

Business 工商管理

Balanced routing optimizes service centre operation
平衡分配方法優化服務中心運作

Dr Ye Hengqing
葉恒青博士

Research on balanced routing helps to minimize service system workload and optimize system performance.

平衡分配方法的研究，有助將系統工作量減到最低，以及優化系統性能。

Dr Ye Hengqing, Associate Professor of the Department of Logistics and Maritime Studies, has co-authored a research paper entitled “Asymptotic Optimality of Balanced Routing” with Prof. Chen Hong from the Sauder School of Business at the University of British Columbia. The paper has been accepted for publication by *Operations Research*.

Routing control is a key component in many engineering and service systems. With a system of parallel servers, an arriving job can be dispatched to any one of the servers. By observing the queue-lengths of all servers, the join-the-shortest-queue (JSQ) policy can be applied, usually with good results. However, retrieving the queue-length information, as required by the JSQ policy, may be costly in many situations. For example, when a manager assigns job orders or inquiries to a number of customer service officers in a service centre, he may incur excessive communication costs if he reviews the number of pending jobs for each officer when each job arrives. In a mirror system, the same data is stored on geographically distributed web servers. In such a system, tracking the state of all servers upon each download request will cause a prolonged delay in response and generate overhead traffic.

In view of this, the two academics study a so-called balanced routing policy, under which a few servers are randomly selected upon the arrival of each job and the job is routed to the one with the shortest queue. Their paper establishes that such a policy asymptotically minimizes the system workload and evenly distributes the work among all of the servers. These findings demonstrate that the balanced routing policy offers an appealing tradeoff between reducing information retrieval and optimizing system performance.

物流及航運學系副教授葉恒青博士與英屬哥倫比亞大學尚德商學院陳宏教授合著題為「平衡分配的漸近最優性」的論文，獲得 Operations Research 承諾刊載。

在很多工程和服務系統中，分派控制是重要的一環。在並行伺服器系統中， 接收的任務可能分配到任何一個伺服器。如果能了解所有伺服器的排隊情況，系統就可以將任務按照最短隊列原則分派，一般而言效果不錯。然而，在許多情況下，檢索隊列長度資訊可引致成本高漲。例如：當管理人員要將訂單或查詢專案分派給服務中心的多位客戶服務員時，假如在接到每項任務後都查閱每位客戶服務員的有待完成任務，這就可能涉及高昂的溝通成本。在鏡像伺服器系統中，相同的資料都儲存在不同區域的網路服務器，如果每次接到一個下載要求都要檢查所有伺服器的狀態，這就會延長伺服器的反應時間及資料流程量。

因此，兩位學者探討一種平衡分配方法，讓系統在接到一項任務的時候隨機選出若干伺服器，將工作任務送到最短的一個隊列。這項研究證明該方法能夠將系統工作量減到最低，同時將工作平均地分配到所有伺服器。研究結果顯示這是一種可取的方法，能夠在減少資訊檢索與優化系統性能之間取得平衡。