Novel system to prevent floods
防洪新系統

Dr Chau Kwok-wing, Associate Professor of the Department of Civil and Structural Engineering, has been honoured with a State Science and Technology Award (second class) from the State Council for a joint research project entitled “Multiobjective decision making and rainfall-runoff prediction theories for complex flood control system for reservoirs”.

Working in collaboration with Prof. Cheng Chun-tian of the Dalian University of Technology and Prof. Li Deng-feng of the Dalian Naval Academy, Dr Chau has developed a sophisticated theory that takes into consideration different factors related to the prediction of rainfall and flooding.

This theory provided a solid foundation for the subsequent development of a reservoir flood-control operation system pioneered by Dr Chau and his team, who took 60 reservoirs and four river basin floodwater forecasting systems in the Chinese mainland as their models.

The newly developed system allows decision makers to analyse and forecast floodwater levels based on their existing knowledge, historical flood control cases and real-time information. This facilitates the formulation of flood control proposals in a timely manner. The expandable nature of the system also renders it highly practicable, and its forecasting accuracy is greater than 90 per cent.

To date, the system has been installed in more than 100 medium- to large-sized reservoirs in the Chinese mainland. It has also been successfully applied to the flood control system centred around the Three Gorges Reservoir for flood system planning, and to the Liao, Hun and Tai rivers for the real-time operation of reservoirs.

理大土木及結構工程學系副教授周國榮博士憑聯合研究項目「複雜防洪調度系統的多目標決策及徑流預報理論」，奪得「國家自然科學獎」二等獎。

周博士與大連理工大學程春田教授及海軍大連艦艇學院李登峰教授聯手，根據與預報降雨量及洪水情況有關的各種因素，研發出一套精密的理論。

這理論為研究人員其後研製的一套洪水調度管理系統，建立了堅固的基礎。周博士及其研究團隊以中國內地的六十座水庫和四個流域洪水預報調度系統為原型，開發有關系統。

該創新的系統讓決策者融合其知識和經驗，並參考洪水調度歷史案例與實時數據，分析及預計洪水程度，從而幫助他們作出適時的調度決策。該系統強調使用的可擴充性，為在實際環境下調度洪水提供了有效的方法，預報精確度達百分之九十以上。

該系統現已安裝於中國內地一百多座中型及大型水庫，並成功應用於以三峽為中心的庫群防洪系統規劃，以及遼渾太流域等即時庫群洪水調度系統。

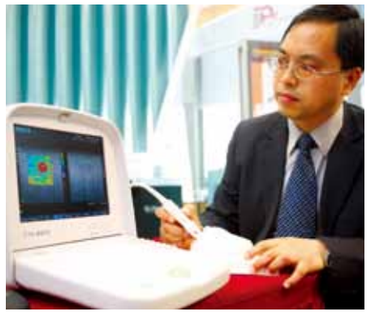
New equipment makes breast cancer diagnosis more accurate and convenient

新儀器診斷乳癌更準確方便

Breast cancer is a leading cause of death worldwide and is the fastest growing cancer amongst women in Hong Kong. Making use of advanced ultrasound technology, a research team led by Prof. Zheng Yongping, Professor of the PolyU Department of Health Technology and Informatics and Associate Director of the Research Institute of Innovative Products and Technologies, has successfully developed a low-cost and compact Ultrasound Elasticity Imaging System for the examination and diagnosis of breast cancer.

In collaboration with the Shantou Institute of Ultrasound Instruments Co Ltd, a Guangdong-based ultrasound diagnostic company, and with funding support from the industry and the Hong Kong SAR government, the research team has incorporated a novel algorithm into conventional ultrasound scanners to achieve elasticity imaging.

The basic principle underlying elasticity imaging is the mapping of tissue stiffness so that the tumour region can be clearly viewed. The technique is similar to manual palpation with the fingers, but is more accurate in medical imaging and produces quantitative information. It has been reported that ultrasound elasticity imaging together with conventional B-mode imaging can significantly improve the accuracy of breast cancer diagnoses. It is particularly important that women below the age of 50 undergo ultrasound breast cancer screening because mammography is normally not suitable for them, given the density of the breast tissue at a younger age. The University has filed a patent for this breakthrough technology.



乳癌是全球最致命的疾病之一，亦是在香港婦女中增長最快的癌症。理大醫療科技及資訊學系教授兼創新產品與研究所副所長鄭永平教授領導的研究小組，利用先進的超聲波技術，成功研發一套低成本、體積輕巧的超聲波彈性成像儀器，可用於檢查和診斷乳癌。

研究人員得到香港特區政府及業界的資助，並與汕頭市超聲儀器研究所有限公司（總部設在廣東省的超聲波儀器製造商）合作，把新的彈性成像演算法安裝在傳統超聲波儀器內。

彈性成像的基本原理是按組織硬度成像，使人可以清楚看到腫瘤區域。該技術類似手指觸診檢查，但輔以醫療成像和量化數據，使結果更準確。有報導指出，超聲波彈性成像與傳統的B超成像並用可以顯著提高乳癌診斷的精確度。乳癌超聲波診斷對於五十歲以下的女性尤其重要，她們通常不適合進行乳房X光造影檢查，因為其高密度的乳腺組織會影響檢查結果。理大已經為這項突破性技術申請專利。

PolyU researchers have been working with hospitals in Guangdong and Shanghai to use the new system in clinical trials, and are looking for collaboration opportunities with hospitals and clinics in Hong Kong.

The system is the first Chinese ultrasound scanner to have an elasticity imaging function, and is a successful example of how the University's cutting-edge applied research can add value to manufacturers in the Pearl River Delta Region.

理大研究人員正計劃在廣東省和上海市內的醫院利用新儀器進行臨床測試，亦期望與本地醫院及診所加強合作。

這是首部中國製造、配備彈性成像功能的超聲波掃描儀，足證理大的尖端應用技術可以為珠江三角洲地區的製造商增值。

Comparison of existing technology with the new system 現有技術與新儀器之比較

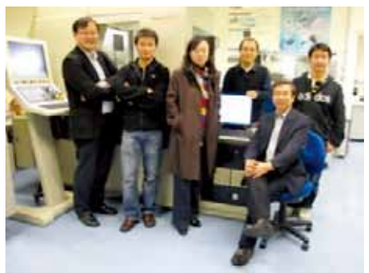
	Existing ultrasound diagnostic machines with elasticity function 現時備有彈性功能的超聲波診斷儀器	PolyU-developed ultrasound elasticity imaging system 理大研發的超聲波彈性成像儀器
Size 體積	Bulky, about the size of a three-door refrigerator 笨重，猶如一台三門冰箱	Compact, about the size of a desktop computer 輕巧，猶如一部桌上電腦
Cost 價錢	About HK$1-2 million 約一百萬至二百萬港元	Manufacturing cost can be reduced by one-tenth, making it more accessible to the community at large and to less developed countries 生產成本可以削減百分之十，讓一般社區和落後國家也可以採用
Availability 適用地方	Primarily for use in hospitals 主要供醫院使用	Can be easily installed in clinics, making breast cancer screening more convenient and allowing the earlier provision of treatment 可以輕易地裝設於診所內，使乳癌診斷更方便，並可及早為病人作出治療

At the 13th China Beijing International Hi-Tech Expo held in Beijing in May, Prof. Zheng (first from right) introduced the PolyU-developed ultrasound elasticity imaging system to Ms Liu Yandong (first from left), Member of the Political Bureau of the CPC Central Committee and State Councillor. Ms Liu said she hoped that Hong Kong and mainland enterprises could further their collaboration and exchanges in science and technology.

第十三屆中國北京國際科技產業博覽會五月於北京舉行，鄭永平教授（右一）在會上向中共中央政治局委員、國務委員劉延東女士（左一）介紹理大研發的超聲波彈性成像儀器。劉女士表示希望香港與內地的企業進一步加強在科技方面的交流合作。

Ultra-precision machining technology helps develop optoelectronic industry

超精密加工技術有助發展光電信息產業



The PolyU research project entitled "Ultra-Precision Machining Technology of Freeform Optics and its Applications" recently won the 2009 Higher Education Institution Scientific Research Outstanding Achievement Awards-Technology Progress Award (Second Class) presented by the Ministry of Education's Centre for Science and Technology Development. The principal researchers, from the Department of Industrial and Systems Engineering, include Prof. Lee Wing-bun, Dr Cheung Chi-fai, Dr Sandy To Suet, Dr Jin Bo-jiang, Mr Kong Ling-bao and Dr Wang Wen-kui.

The rapid development of ultra-precision machining technology is enabling the fabrication of non-rotational symmetry freeform optics, and ensuring the supply of high quality but low cost optical components for the optoelectronic industry.

The project team began researching the mechanism of ultra-precision technology in 1990 and was the first to develop the design and manufacturing capability of freeform elements and optical microstructures for photonics and telecommunication products in Hong Kong and the Chinese mainland. It has successfully developed five technological innovations and an integrated system for optical design, ultra-precision machining and the precision measurement of freeform optical components.

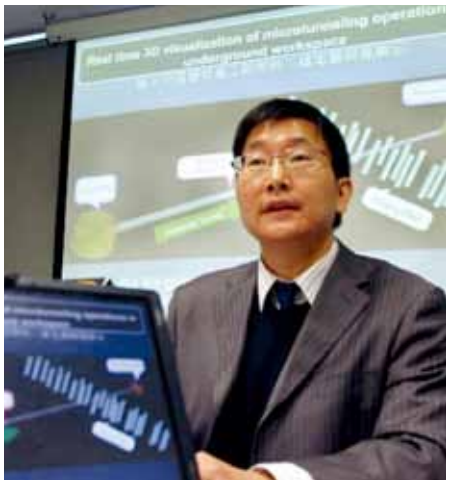
理大研究項目「自由曲面光學的超精密加工技術及其應用」日前獲教育部科技發展中心頒發「二零零九年度高等學校科學研究優秀成果獎—科學技術進步獎（二等獎）」。項目主要研究人員均來自工業及系統工程學系，包括：李榮彬教授、張志輝博士、杜雪博士、蔣金波博士、孔令豹先生及王文奎博士。

超精密加工技術的迅速發展，可為非回轉對稱的自由曲面光學元件進行加工，為光電信息產業提供質優價廉的光學組件。

項目小組早於一九九零年開始超精密加工技術的機理研究，並率先在香港和中國內地提出《開拓用於光電技術及通訊產品的自由曲面光學組件之設計及製造能力》的研究課題，成功研發了五項創新技術以及一個自由曲面光學設計、加工、測試一體化的集成系統。

"Trenchless" technology for underground pipeline fosters sustainable urbanization

非開挖式鋪設地下管道技術 有助城市可持續發展



Working in collaboration with the industry and utility companies, civil engineering experts at PolyU have made great strides in expediting the use of "trenchless" technology for installing underground utility pipelines in Hong Kong. This technology will help minimize the nuisance of public works for both traffic and businesses on the surface.

According to Dr Lu Ming, Associate Professor at the Department of Civil and Structural Engineering, the use of microtunnelling and pipe jacking to install subsurface pipelines is more community and environmentally friendly than traditional trench digging for well developed, densely populated cities such as Hong Kong.

Led by Dr Lu, the academia-industry research team has developed the *TunnelingGSV* (GSV stands for guide, sense and visualize) system. This is coupled with a sophisticated micro tunnel boring machine (TBM) that operates like an underground robot for piping work.

TunnelingGSV continuously and automatically surveys the TBM's positions by a robotic total station and identifies any tunnel alignment deviations in real time.

Through wireless data communication and computer visualization, *TunnelingGSV* renders the underground working environment in real-time 3D computer graphics, supplemented with the use of Internet technology to enhance communication. This breakthrough provides engineers with greater convenience in microtunnelling and pipe jacking based on the integration of automated data collection and real time computing.

With the assistance of the Hong Kong and China Gas Company Limited, CLP Power Hong Kong Limited, Black & Veatch, Kum Shing Construction Company Limited and Reliance-Tech Limited (a subsidiary of Chun Wo Development Holding Limited), the first prototype of the *TunnelingGSV* system was put to work at a microtunnelling site near So Kwun Wat in Tuen Mun for a three-month field trial in late 2009. Coupled with a $12 million micro TBM, the system was successfully implemented in the installation of a 55m long section of a 220m-concrete tunnel 1.2m in diameter laid under a 40m wide nullah.

理大土木工程學專家與業界及公用事業機構合作，致力推廣非開挖式鋪設地下管道技術在本地的應用。這技術有助減少工程對路面交通及商業運作的滋擾 。

理大土木及結構工程學系副教授鹿明博士表示，利用非開挖式微型管道及頂管技術來鋪設地下管道，相比傳統的方法，更符合社區利益及更環保，適用於香港這種高度發展、人煙稠密的地方。

由鹿博士領導的研究團隊包括學術界及業界人士，他們研發出自動式隧道鑽挖機的實時監控系統，簡稱*TunnelingGSV*，這是一套集導航、感應及可視化於一體的系統。它可配備於先進的微型隧道鑽挖機，操作猶如一部地下機械人。

*TunnelingGSV*持續利用智能化全站儀，自動測量隧道鑽挖機的座標，即時計算隧道的調準偏差。

*TunnelingGSV*透過無線數據傳送及圖像化處理，配以互聯網技術，把地下工作環境，如隧道鑽挖機的位置、設計管道、管道施工偏差、現存地基及管道等，即時轉化成三維電腦圖像呈現於眼前。這一突破把自動收集得來的數據進行即時運算，然後應用於微型管道和頂管施工技術中，為工程師帶來極大方便。

參與是次研究項目的機構包括香港中華煤氣有限公司、中華電力有限公司、博威工程顧問有限公司、金城營造有限公司及Reliance-Tech有限公司(俊和發展集團成員)，在他們的支持和協助下，由理大研發的首部*TunnelingGSV*系統樣機於二零零九年年底安裝在屯門掃管笏一個微型管道施工地盤，進行為期三個月的實地測試。該系統樣機安裝於一套價值一千二百萬元的先進微型隧道鑽挖機，成功監控（全長220米）其中一段長55米、直徑1.2米、鋪設在40米闊的水道之下的混凝土管道。