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Thank you for your interest in the innovations of CUHK.

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

創新科技中心
促進中大技術轉移

作為一所具前瞻性的研究型綜合大學, 香港中文大學(中大) 擁抱熱誠追求卓越的創新科研。創新科技中心樂意與您分享其中部份的最新研究成果，它們來自中大多個不同部門及充滿熱情的研究團隊。

創新科技中心作為參屬於中大工程學院的技術轉移部門，是連繫大學與業界的橋樑，以促進中大研究團隊與業界的交流與合作為己任，同時亦透過向社會和業界的技術轉移，推動創新。

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謹此感謝您對中大創意發明的興趣。

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黃錦輝教授
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Interactive Virtual Anatomy System
互動式虛擬解剖系統

A medical education device that allows user to navigate human body slices easily and intuitively
讓用戶透過簡單直觀的操作方式查看人體切片圖像的醫學教育設備

- The system makes use of the high-resolution CVH image data set
- The slice images are rendered in real-time using Graphic Processing Unit (GPU)
- More than 900 organs and label information can be shown at the same time

Chinese Visible Human (CVH) Image is a huge data set with 3640 human body slice images, totaling more than 131GB. If we use conventional software to navigate the data set, the loading process will be very slow. Moreover, these images are usually in a constant direction and are lack of labels. Our developed system, CVH-Slicer, consists of a human body model, a sensor and navigation system. Users can navigate human body slices at different positions and angles in real time simply by moving the handheld controller around the model.

- 基於高解像度的中國可視人資料庫
- 利用圖形處理器進行計算技術，實時顯示高解像度的人體切片圖像
- 可同時顯示超過900個人體器官和的標註信息
- 中國可視人(Chinese Visible Human)資料庫有3640個切片圖像，合共超過131GB數據。如果單單用軟件查看，載入圖像過程將非常緩慢。而且軟件往往只顯示一個方向的切面，又沒有圖像標註。CVH-Slicer配備人體模型、感應器和導航儀，用戶只需把控制器在人體模型上移動，即可實時看到不同位置和角度的人體切片圖像。
Virtual Acupuncture System

An interactive platform for learning human body acupoints systematically

Not only demonstrate the position of the acupoints, but also the anatomy and clinic treatment information.

The system consists of two parts, allowing users to understand the human meridian-collateral system, acupoints distribution, and acupuncture clinic treatment etc.

1. Meridian-collateral system:
   Demonstrates the circulation and distribution of the meridian-collateral with individual explanations

2. Acupoints anatomy system:
   Checks the distribution and location of each acupoint

系統分為兩部分，讓用戶學習人體經絡的組成，穴位分佈及針灸臨床治療等知識

1. 經絡系統：展示經絡的循環路徑，並解釋各經絡
2. 穴位系統：查看人體系統各穴位的分佈及位置
Integrated Development Platform for Intelligent Ultrasound Medical Systems
智能醫學超聲系統的綜合開發平台

The first comprehensive software toolkit that provides advanced medical ultrasound image processing algorithms for the rapid development of intelligent medical ultrasound measurement, diagnosis and intraoperative guidance systems.

首個提供前沿醫學超聲算法以快速開發智能醫學超聲測量、診斷和術中引導系統的完備軟件工具包

- Provide more reliable evidence to doctors for diagnosis and treatment
- Combine long-term research and development experience of Hong Kong and Shenzhen experts in this field
- Provide examples to demonstrate how to use the algorithms: Intelligent fetal ultrasound detection and measurement system, 3D fetal ultrasound visualization system, Intelligent ultrasound-guided mastectomy training and planning system

Ultrasonography is widely used in clinical practice. However, due to the limitations in current imaging technology, the quality of ultrasound images is often affected by artifacts and speckle noise. The weak penetration capability of ultrasound through bone and gas also makes deep tissue imaging difficult. We employ intelligent information processing technology to enhance the quality and content of ultrasound images, and set up a software toolkit for the development of different ultrasound medical systems.

醫學超聲被廣泛應用於臨床診斷和治療。然而，受成像技術的限制，圖像質量往往受偽像、雜訊等影響，而由於超聲對骨質和氣體的穿透性弱，要獲取人體深層組織影像較困難。我們利用智能資訊處理技術增強超聲圖像的品質和內容，並建立可以開發不同智能醫學超聲系統的軟件工具包。
Wearable Sensors For High Accuracy Blood Pressure Monitoring
穿戴式高精度血壓感測器

Unobtrusive sensors for real-time, continuous and precise Blood Pressure measurements
無擾、實時、持續且精確的血壓測量

The small sensors can fit comfortably to skin, providing continuous BP monitoring
感測器細小，可舒適地緊貼皮膚，持續監測血壓

- Our sensors are extremely flexible, thus can form comfortable and seamless contact with the skin, minimizing measurement errors caused by motion artifacts.
- By combining optical and mechanical probing, we can develop a multimodality BP monitoring system, enhancing significantly the measurement accuracy.

- 柔性感測器可舒適且無縫緊貼皮膚，將運動影響所造成的測量誤差降至最低
- 我們可結合光學和力學探測以建立一個綜合的血壓監測系統，大大提高測量精度

The fast aging population underscores the urgency to develop personal healthcare systems that can frequently collect physiological parameters of patients during their daily life, thus allowing early disease detection and timely treatments. Our wearable sensors allow around-the-clock measurement of ambulatory and nighttime Blood Pressure (BP), which have been shown to be superior risk predictors for the prevalent cardiovascular diseases.

隨著高齡人口迅速增長，我們迫切需要發展能在日常生活中收集病人生理參數的醫療保健系統，以及早檢測疾病及提供適當治療。心血管疾病愈趨普遍，日間和夜間血壓是其重要的風險指標。我們的穿戴式感測器可持續且精確地測量血壓，對健康監測十分重要。
Motion Tracking System for
Dynamic Assessment of Knee Function
評估膝關節動態功能的動作追蹤系統

A novel system for assessing ACL function during dynamic knee movements
透過追蹌膝關節的動態運動評估前交叉韌帶功能之新型裝置

- Simple calibration protocol
- Objective and reliable
- Non-invasive measurement of knee joint kinematic data (rotation and translation)
- Compact and space-saving design
  with 2 integrated and adjustable infrared cameras and a high-speed camera
  that simultaneously record both kinematics and visualized data during dynamic knee motions.

Anterior cruciate ligament (ACL) injury is a common sports injury, which results in an unstable knee. Current clinical examinations on knee laxity are easily influenced by examiners’ experiences and skill; while only limited information on static and passive anterior-posterior translation can be obtained with current knee assessment devices. Our clinician-friendly motion tracking system offers dynamic assessment over the knee joint, as well as a standardized clinical testing protocol. The system can be used in diagnosis and prognosis of ACL-deficient patients, and comparisons of different surgical and rehabilitative regimes.

膝關節前交叉韌帶(ACL)損傷是常見的運動創傷，會降低膝關節的穩定性。目前針對膝關節鬆弛度的臨床檢查較易受檢者的經驗和技術影響，而現有的檢測裝置只能測試膝關節在靜止和被動的狀態下的矢狀位移。我們研發出能評估膝關節動態功能的簡易裝置，並制定臨床標準測試方案，可應用於ACL損傷的診斷和預後，及比較不同手術及康復方案的效果。
Computerized Simulation of Cleft Lip and Palate Surgery Outcome

Simulation of the post-operation facial deformation of Cleft Lip and/or Palate patients based on 3D medical images and Finite Element Method (FEM) theory

Cleft lip and/or palate (CLP) is one of the relatively common diseases in newborn congenital anomalies. The repair surgery comprises a number of operations at different stage as the child grows. However, there is no sound evidence base for the selection of treatment protocols due to the striking diversity of surgical care practices. It is also hard to forecast the post-op facial deformation. Surgeons and patients' families could find it hard to determine the best surgical plan. This project will build an individualized biomechanical model of the upper lip and palate based on 3D medical images and finite element method (FEM) theory for the prediction of the patient's post-op instauration.
Computer Platform for Noninvasive Diagnosis of Abnormal Vasculatures
無創式血管異常結構診斷電腦平台

Allow doctors to study hemodynamic conditions based on 3D medical images and computational fluid dynamics
利用三維醫學影像和血液流動學讓醫生評估血流狀態

- Noninvasive and minimal examination procedures
- Promote early detection of vascular diseases
- Allow doctors to better understand the patient’s condition and provide personalized medication
- Improve the prevention and diagnosis of related diseases

Vasculature Abnormality refers to the unnatural growth of blood vessels that leads to oscillation blood flows. The lack of nutrients and oxygen supplies would lead to serious damage to body cells. At present, doctors can only assess the severity of the conditions by angiography, ultrasound or invasive operations, causing extra exam time, cost and physical harms to patients. Thus, we developed a computer platform which allows doctors to study patients’ hemodynamic conditions based on 3D medical images from Computerized Tomography (CT) and Magnetic Resonance Imaging (MRI) and the techniques of computational fluid dynamics.
Glasses-free 3D Visualization Suite for Medical Images

Real-time 3D image display unit for diagnosis and surgery

Medical images are indispensable for studying the anatomic structure of patients in vivo. The images, which are commonly visualized with 3D computer models, provide abundant spatial and time-dependent information for diagnosis and surgical planning. Our glasses-free 3D visualization suite is equipped with a GPU-accelerated volume rendering algorithm, enabling real-time interactive and responsive visualization of 3D medical images.

- Glasses-free 3D display units allow medical professionals to realize and understand the 3D inter-relationship more efficiently than conventional 2D monitors.
- Medical professionals can access the information from CT/MRI/US images easily, which helps to reduce diagnosing time.
- Surgeons can understand the spatial relationships of the organs from the 3D images more accurately, and use it as guidance during operations.

- 新型的自動化立體顯示屏可無須特殊眼鏡輔助，較傳統的平面顯示方法更能讓醫療人員準確地閱讀及理解器官的三維關係。
- 有助醫療人員輕鬆地從電腦掃描、磁共振及超聲圖像中獲取所需信息，縮短臨牀診斷時間。
- 有助外科醫生從立體圖像中準確獲取病灶的空間位置，作術中導航。

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Low-cost high-efficiency measuring device for blood viscosity

The microfluidic device is about 50mm x 50mm large only; can be made portable for point-of-care tests.

Blood viscosity can be obtained by comparing the flow rate of the sample and the reference fluids.

High blood viscosity has been shown to link with the major cardiovascular risk factors, including high blood pressure, elevated LDL cholesterol, low HDL cholesterol etc. It is therefore a good indicator of potential cardiovascular disease. By introducing just one small drop of blood in our uniquely designed microfluidic device, we can measure blood viscosity simply by taking time-lapse photos of the flowing blood sample and the reference fluid, and then comparing their flow rates.
Protein Microarrays with Ultra-low Background Signal
超低背景雜訊的蛋白質芯片

Novel high-efficiency substrate for bioanalysis and clinical diagnosis
用於分析及診斷的全新高效能基底

- Extremely low background noise
- Low fabrication cost
- Reduced consumption of samples and reagents
- Resolve the common issue of coffee-ring morphology of the spots
- No complicated surface treatment nor special printing solution is required as in traditional substrates

Droplets on the microarray substrate after the paraffin oil being removed

Deposition of the droplets on the microarray substrate immersed in the paraffin oil

The substrate in a microarray platform is critical to the analysis result in terms of signal consistency and detection sensitivity. We developed a novel substrate using fluorinated ethylene propylene (FEP) membrane, which provides many advantages over traditional substrates such as glass and nitrocellulose. We will focus on applying the protein microarray to early diagnosis of cancers and autoimmune diseases.

Mixing of the droplets on the microarray substrate immersed in the paraffin oil

在微陣列檢測平臺中，基底的選擇直接影響檢測結果的一致性和靈敏度。我們研發使用氟化乙烯丙烯（FEP）製造的新型基底，比玻璃、硝化纖維等傳統基底令檢測更有效率。我們將集中將這蛋白質芯片應用於癌症和自身免疫性疾病診斷。
Environmental & Green Technologies
環保和綠色技術
Portable Air Pollution Monitoring System
便攜式空氣污染監測系統

An ultra-sensitive, wide-dynamic-range, low-cost and portable gas sensing system
高靈敏度、寬動態範圍、低成本、可便攜的氣體檢測儀

The portable air pollution monitoring system is as small as 10cm x 10cm x 10cm
便攜式空氣污染監測系統的體積只有約10厘米x10厘米x10厘米

Air pollution is a great concern for the public's health and the society's economy. Precise measurement of air pollutants is one key step to tackle the problem. Current commercial trace gas detectors make use of expensive photodetectors for light intensity measurement. They have large system size, limited dynamic range and high cost. Taking advantage of the cutting-edge quartz-enhanced photoacoustic spectroscopy (QEPAS), we developed a portable gas sensing system using a low-cost quartz tuning fork to detect the acoustic signals generated during laser adsorption.

- Portable: Air pollution monitoring is made feasible at almost any locations; coupled with smart and remote data processing and transfer, the system can even be delivered by unmanned drones to remote locations for data collection
- Low cost: 50-100 times cheaper than current systems
- Ultra-sensitive: Ppb level sensitivity
- A nitric-oxide detector has been developed; can be easily adapted for other air pollutants such as formaldehyde, hydrogen peroxide, ozone, and hydrogen chloride by employing different laser sources

- 便攜式：可以在幾乎任何地點進行空氣污染監測; 配合智能遠程數據處理及傳輸，更可用無人機將系統送到難道的一些難以收集數據的地區
- 成本低：比現有系統便宜50-100倍
- 高靈敏度：十億分之一（ppb）測量精度
- 已成功開發二氧化氮檢測儀，只需簡單替換激光源，就可以應用到甲醇、過氧化氫、臭氧以及氯化氫等污染物質

空氣污染對公眾健康和社會經濟帶來損害，準確測量空氣中的污染物，是解決空氣污染問題的重要關鍵。現有的氣體分析儀使用高成本的光檢測器測量光強度，系統體積巨大，測量動態範圍有限，且價格昂貴。我們基於石英增強光聲光譜技術，利用非常便宜的石英音叉檢測器激光吸收而產生的聲波信號，從而研發出便攜式的氣體檢測儀。
Thermal Energy Harvesting and Storage for Wireless Sensor Networks

Converting low-grade heat to electricity for sustainable autonomous wireless sensor networks (WSNs)

• Novel technology from the development of thermoelectric device and rechargeable battery, to the design of power management circuit
• Improve the system reliability of WSNs
• Reduce the labor and cost associated with replacing hundreds or thousands of batteries used in the WSNs
• Enhance overall building efficiency by transforming waste heat into useful power source

WSNs are widely applied in our daily life, e.g. area monitoring, health care monitoring, air pollution monitoring etc. Replacement of WSNs' batteries can be difficult as they are often of large-scale and it may also disrupt the continuity. Therefore, we develop an integrated technology that can convert low-grade heat that naturally exists in buildings (e.g. solar heating, pipe lines, generators) to electricity to sustainably power autonomous WSNs.

無線傳感器網絡 (WSNs) 廣泛應用於我們的日常生活當中，例如環境監測、健康監測、空氣污染監測等。更換WSNs的電池是一項艱鉅的工作，因為多數WSNs都很大型，而且更換時亦可能中斷了監測的連續性。我們開發出一種集成技術，將建築物內自然存在的低級熱能（例如太陽能加熱、熱管線、發電機餘熱等）轉化為電能，以供自主無線傳感器網絡持續使用。
Information & Communication Technologies
信息和通訊科技
Seamless Visual Sharing with Colour Blind People
色盲人士視覺共享系統

Allow individuals with Colour Vision Deficiency (CVD) to share the same visual content with normal-vision audiences simultaneously
讓色盲人士與正常色覺人士共享視覺內容

- CVD audiences wearing stereoscopic glasses will be able to distinguish the originally indistinguishable colours when presented with computer synthesized binocular images
- When normal-vision audiences (without stereoscopic glasses) view the monocular images, there is visually no difference from the original image
- Can be applied in all 3D visual display device e.g. home TVs, movie theaters, mobile screens
- Our method is extensively evaluated via multiple quantitative experiments and user studies, with convincing results obtained in all test cases

世界上有大約兩億五千萬的色盲人士，現存一些協助色盲人士區分顏色的技術，但都需要改變原圖的顏色。當觀眾同時有色盲人士和正常色覺人士，這些技術就不適用了。我們利用了3D顯示器的兩個不同觀影模式（戴上3D眼鏡和不戴3D眼鏡），開發了首個讓色盲人士和正常色覺人士共享視覺內容的系統。

Approximately 250 million people suffer from colour vision deficiency (CVD). There exist methods that help colourblind people to distinguish colours via changing the colours in the original images/videos. It is, however, not practical in sharing scenario where there are both CVD and normal vision audience. Making use of stereoscopic display which offers users two visual experiences (with and without wearing stereoscopic glasses), we propose the very first system that allows CVD and normal-vision audiences to share the same visual content simultaneously.
Automatic Toon Tracking
自動化卡通追蹤

Automatically identify designated objects/regions from an animation sequence for automating animation modification
自動從動畫的幀與幀之間辨識出指定物件或區域以作自動化動畫編輯

- Consistently outperform the state-of-the-art methods when evaluated with various animation sequences
- No manual assistance needed
- May convert a 2D cartoon into stereo or convert a black-and-white cartoon into coloured version via depth/color propagation
- New inbetweening frames can be created by morphing, producing high-quality smooth-motion animations without increasing labor cost

Correspondence identification is to identify objects or region correspondences between consecutive frames of a given hand-drawn animation sequence. It enables automating animation modification tasks such as sequence-wide recolouring or shape-editing of a specific animated character. Existing methods heavily rely on appearance features, and fail to correctly identify correspondences when there exist occlusions, multiple similar/same objects, or split/merged regions. Manual assistance is often required. Our novel approach incorporates motion analysis and analyzes correspondences in a global manner, resolving the abovementioned complex scenarios.

「動畫對應關係辨識」是指分析手繪動畫中幀與幀之間物件或區域的相應關係。這技術令動畫編輯能夠自動化 - 例如自動更改指定角色的顏色或形狀。現有的動畫對應關係分析算法都僅僅依賴物件的外表特徵，以至未能在一些複雜的場景下（例如：物件互相遮擋、場景中有多個相似/相同的物件、區域之間存在分離/融合等）辨識出正確的對應關係，需要手動修正。我們的最新技術加入了區域運動軌跡分析，全局地分析對應關係，解決了以上複雜場景的問題。
Optimized 3D Images
3D視覺影像優化

Enrich contrast and fine details of 3D images using the phenomenon of “Binocular Single Vision”
利用雙目影像融合的原理令三維影像的色彩和細節更豐富

There is in fact always some minor difference between the visions of our left and right eyes. For example, there will be disparity of an object if it is viewed from our left and right eyes respectively. We seldom notice such difference because our brains can naturally fuse the two different views. During 3D image processing, either contrast or fine details will be sacrificed when the Low-Dynamic Range (LDR) image is produced from the High-Dynamic Range (HDR) image. Based on the binocular single vision phenomenon, we developed a novel computational technique to generate a pair of LDR images which preserves the contrast and the fine details respectively. Visuals with good contrast and details will be resulted when viewers perceive the left and right images through 3D devices.

The very first attempt in computer graphics area to enrich visual experience with binocular single vision
A computational model is developed to predict the limit of image difference such that no visual discomfort will be caused
Can be widely applied in 3D movies, 3D video games, Virtual Reality (VR) etc.

- The very first attempt in computer graphics area to enrich visual experience with binocular single vision
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Deep Automatic Portrait Segmentation and Matting

A deep learning system for fully automatic image segmentation and matting

Applications of automatic portrait segmentation and matting

- Fully automatic: Large-scale image editing is feasible with tedious manual input eliminated
- High performance: Conventional applications require users' interactions for several seconds to a few minutes while ours takes less than one second without any user interactions
- High quality results: Trained with a large dataset with human labeled ground truth, our system outputs satisfying results and continues to advance

With the prevalence of smartphones and self-portrait photography, i.e., selfie, image enhancement software is getting popular for portrait beautification and stylization. Image segmentation and matting, which plays an important role in these editing applications, require tedious interactions from users to separate the image's foreground and background. Even with the users' input, it is difficult to output satisfying results. To address this issue, we propose a convolutional neural network (CNN) based deep learning system for automatic portrait segmentation and matting.

隨著智能手機的普及，愈來愈多人喜歡「自拍」，能把圖像美化、風格化的修圖軟件應運而生。圖像分割和提取是這些應用軟件的重要技術，但這需要用到人員繁複的操作去分開圖像的前景和背景，而且往往難以達到令人滿意的效果。有見及此，我們提出了一個基於卷積神經網絡的深度學習自動人像分割和提取系統。
MemEC: Erasure Coding for Small Objects in In-Memory Key-Value Storage

Specially designed for workloads dominated by small objects

Erasure coding has been widely adopted in distributed storage systems for fault-tolerant storage with low storage redundancy. However, real-life key-value storage workloads (e.g., Facebook) are dominated by small objects, whose keys and values are of small sizes; whereas erasure coding cannot be directly applied on an extremely small object, and cannot provide low-latency while maintaining the correctness of ongoing requests. We therefore propose our new all-encoding data model, MemEC.
Temporal Network Data Management and Analytic System
時序網絡數據管理及分析系統

An effective system for companies to discover values in their temporal network data
讓企業有效地從時序網絡數據中提取有價值的信息

- Efficient processing of temporal network data for analysis such as online shopping (e.g., transaction time), marketing campaign (e.g., time of advertising/promotion), internet usage behavior (e.g., time-ordered sequence of web search and visit) etc.
- User friendly Application Programming Interface (API) that allows companies to design analysis that suits their needs and purposes
- Support small-scale companies with a single PC to a few PCs, to large-scale companies with hundreds to thousands of computers

Big data analysis is now a trend for companies to plan their business. Current techniques focus on the analysis of non-temporal network data, but are inadequate and inefficient in processing temporal network data, which often contain much richer and higher value information. In view of this, we develop an efficient temporal network data management and analytic system.

不少企業會分析大數據以作商業策劃，目前市場都集中針對處理非時序式的網絡數據，對時序網絡數據的處理技術又有成熟，但時序網絡數據往往蕴藏更豐富而且更有價值的信息。因此，我們開發出一個高效的時序網絡數據管理及分析系統。
Husky: The Next-Generation Big Data Platform

Super powerful big data engine for end-to-end business solutions

Husky: 新世代大數據平台

超強「大數據」引擎提供一站式商業解決方案

- High performance: 10-100 times faster than Spark for iterative jobs and 2-10 times faster for non-iterative jobs, and with better scalability due to low resource consumption
- General and expressive: naturally supporting machine learning, map-reduce, graph analytics, stream processing, SQL, etc., in one unified framework
- User-friendly: offering Python, Scala and C++ API, and working well on a laptop or a large distributed cluster
- Smooth integration/connection with existing systems (e.g., Hadoop ecosystems, NoSQL key-value stores, etc.)

Husky is a general-purpose platform that empowers big data applications and enables flexible end-to-end business solutions with a rich suite of the most advanced data management and data analytics tools including large-scale machine learning, OLAP, stream processing, MapReduce, graph analytics, etc. It is faster and uses less computing resource than any existing general-purpose big data platforms, enabling companies to effectively and efficiently manage and to find value from their data. We have proven the flexibility and simplicity of Husky in developing high-performance big data solutions for a number of sizeable industrial projects.

Husky是一個多用途平台，應用大數據實現靈活的點對點業務解決方案，並具有最先進的數據管理和數據分析工具，包括大規模機器學習、OLAP、流動數據處理、MapReduce、圖數據分析等。Husky比任何現有的通用型大數據平臺更快及使用更少資源，使企業能夠有效地管理數據並從中提取有用的信息。我們已經進行多個大型業界項目，證明了Husky開發高性能大數據解決方案的靈活性和簡單性。
EduVenture® - VR (Virtual Reality)

A user-friendly web-based composer for teachers to produce VR (Virtual Reality) and AR (Augmented Reality)-based immersive fieldtrips 讓教師製作加入虛擬實境 (VR) 和擴增實境 (AR) 的戶外考察教材的簡易網上編寫工具

EduVenture® VR, the newly developed sub-system of EduVenture®, adopts affordable interactive 360° spherical VR and AR technologies for supporting teachers to produce VR-based immersive fieldtrip learning videos that capture real-world environments layered with AR-based pedagogic scaffolds. Students can go on the virtual fieldtrip via mouse, touch pad, mobile device, Google Cardboard or other HMDs (head-mounted displays).

Website 網址: http://ev-cuhk.net/
3D Resolved Parallel Laser Machining and Metal Additive Manufacturing
三維並行激光加工及金屬快速成型系統

Ultrahigh throughput and ultrahigh precision micromachining
高通量的超精密微加工技術

Direct area micro-machining results on a nickel target (Processing area: 90 x 50 μm²)
直接在銅靶表面微加工樣品（加工面積：90 x 50 μm²）

A set of alphabets were micromachined on the nickel target with a resolution approaching the diffraction limit (6, 500mm).
在銅靶表面微加工字母，精度接近衍射極限（6, 500mm）。

Parallel laser sintering/melting results with a resolution of approximately 20-50 μm - substantially better than the current SLS and SLM processes which typically have a resolution of 100s microns.
平行激光燒結/熔化結果，分辨率約20-50 μm - 明顯優於目前的SLS和SLM過程，通常分辨率為100s μm。

Ultrashort pulse lasers have been extensively used in micromachining. However, its throughput is largely limited by the sequential point-scanning processes. Making use of temporal focusing, our system creates a light sheet of high pulse energy of 50-400 μm diameter, achieving direct area patterning and hence substantially increasing the throughput. The technology is further adopted to develop a metal additive manufacturing system, which will have superior resolution and throughput over current commercial systems.
超短脈衝激光已在微加工中廣泛應用，但產量很大程度上受限於其逐點掃描過程。通過時間聚焦，我們的系統產生厚度為50-400 μm的光片，實現直接面積パターン化，因此大幅提高了產量。此技術將進一步被應用於金屬增材製造系統，較目前商用系統具有更好的分辨率和產量。
Powered Ankle-Foot Prosthesis

Help below-knee amputees to restore a normal gait

Commercially available ankle-foot prostheses are often passive in nature, that is, they cannot provide extra mechanical energy to assist amputees to walk. This is physically demanding for the amputees and they often have to walk slower than normal. One of the major technological challenges for powered ankle-foot prostheses is that it is difficult to build a prosthesis that is small and light enough while able to provide sufficient assistive power for walking. In view of this, we propose a novel powered ankle-foot prosthesis, which is shown to help amputee to walk in close to normal gait during clinical trials.

- Assistive power: The prosthesis provides amputees with assistive power so as to reduce their efforts in walking.
- Lightened battery: The prosthesis is designed based on the human ankle kinematics and parallel spring mechanism to reproduce human ankle dorsiflexion stiffness. Negative mechanical energy therefore can be stored and released for improving system energy efficiency. The battery can hence be lightened.
- Downsized motor: Due to the same reason as in above point, both the actuator torque and power requirement are reduced. The motor can hence also be downsized.

現有的膝下義肢一般都是被動式的，即是不能夠為截肢者提供額外的步行動力。這樣對截肢者的體能需求很大，而且他們需要以較慢的速度走路。設計動力膝下義肢有一項重要的技術挑戰，就是很難在符合體積和重量限制的同時又能提供足夠的步行動力。因此，我們設計出一個全新的動力膝下義肢，並且已在臨床試驗中證明能夠幫助截肢者以接近正常步態行走。
Social Robots for Children with Autism Spectrum Disorders (ASD)

Use robots to teach children with ASD gestures for communication
利用機械人教導自閉症兒童透過手勢溝通

Robots are an effective technological tool for teaching children with ASD to use gestures.

Children with autism have difficulties in communicating what they need, leading to frustration and also challenging and self-injurious behaviors, and in long terms, social exclusion, as well as limited educational and vocational opportunities. Gesture is an effective communication channel for these children to express feelings and needs; while it is found that among different learning media, they prefer robot-like toys to non-robotic toys and human beings. We therefore aim to use social robot to teach children with autism relevant gestures to effectively communicate their needs and feelings, so as to reduce their challenging behaviors and improve their physical health.
If you are interested in any of the projects listed in the booklet
Please contact

Centre for Innovation and Technology
The Chinese University of Hong Kong

如閣下對本刊內任何科研項目有興趣
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