10th Anniversary of ACAOS

Public Education Program on Computer Assisted Surgery with Special Theme on "Technologies Enhancing Patient Care - in the Community"

Celebrating Achievements in Computer Assisted Clinical Management and Surgery developed in The Chinese University of Hong Kong

電腦輔助骨科及外科手術十週年

慶祝香港中文大學電腦輔助手術及臨床醫學發展成就

電腦輔助手術公共教育講座及展覽

「醫工合作 完美醫療」

知識轉移處
Knowledge Transfer Office

香港科學館
HONG KONG
SCIENCE MUSEUM

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Supported by CUHK Knowledge Transfer Project Fund
香港中文大學知識轉移基金支持項目

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1. Forewords

"Once we accept our limits, we go beyond them……"

Albert Einstein

The traditional practice of surgery with the dexterity of the surgeon's hands has been reflected by the excellent care provided to our community. With the ever increasing complexities of surgical procedures, our quest of perfection, the practice of minimally invasive procedures that help our patients recover quicker and better, it is natural that we seek help to other means that compliments the human abilities. Machines that designed by human would be a perfect solution to this demand as we, human, can design them to suit our needs. The advent of computer technologies, both in the hardware and software, could be a perfect match to human abilities.

In 2001, we introduced computer assisted orthopaedic surgery to the orthopaedic community in Hong Kong. While applying the technology to clinical management and patient care, we also actively engaged in the research and development with the aims to improve the technology with the engineering colleagues as well as the industrial partners. With these joint efforts, together with the support from the University as well as the SAR government, we have extended this technology to different fronts: clinical management in wards and clinics, various surgical procedures from the commonest surgery to the most complex surgery in the operating rooms, different training modules to help our staff to take up the technology and we had organised the first international conference with the International Society of Computer Assisted Orthopaedic Surgery (CAOS-International) in Asia to promote and exchange our experience among surgeons from different countries in 2008.

With the ten years of experience, we believe this is a good time for us to review our work as well as to help the public at large to know more about this technology. We sincerely hope that this event will stimulate more people to take up the research and development of the ever-advancing technologies for better patient care!

I would like to take this opportunity to thank the support from the University for sponsoring the first navigation machine in 2001, the Innovation Technology Council for sponsoring our research and development of our unique robots in orthopaedic surgeries, the Knowledge Transfer Office for supporting this event, our industrial partners for sponsoring the research programs as well as numerous workshops in the training of our staff, the Hong Kong Science Museum for co-organizing this meaningful public education event, last but not least, my colleagues in clinical teams, engineering teams and technical teams, for their unfailing support and perseverance in the development of this new technology in Hong Kong.

Professor KS Leung
2011. 09. 10

1. 前言

“唯知不足，始能超越......”

阿爾伯特 · 愛因斯坦

傳統手術依賴外科醫生手工技藝的精湛嫻熟，藉此為公眾提供優質的醫療服務。當今，手術方案日趨複雜，同時，為促進病人盡速康復，微創手術亦大量開展，這些對傳統手工操作提出了相當高的要求。本著精益求精的醫療態度，以上因素促使我們萌發尋求其他方法的設想，以彌補人為能力的不足。人們向來善於設計器械以滿足其需求，以人造裝置來輔助手術應該是最合適不過。隨著電腦技術的出現，其硬體與軟體均可成為人工技能的協助工具。

2001年，我們向香港骨科界引進了電腦輔助骨科手術。隨後，在將該技術應用於臨床治療及病患醫護的同時，為了持續改善，我們聯同工程人員及相關企業積極合作起來，投入到新技術的研究開發當中。通過協作努力，以及香港中文大學與香港特區政府的支持，我們已將該技術拓展到更多領域前沿：門診及病房的臨床治療、手術室最基本至最複雜的各項手術、幫助員工掌握技術的各種培訓課程。2008年，我們還與亞洲及國際電腦輔助骨科手術學會，在香港聯合舉辦了亞洲首屆電腦輔助骨科手術專業學術會議，以促進各國同行間的交流，分享彼此的經驗。

十年鑄劍，鑒於長期的經驗積累，我們認為此時適值總結過往、計劃未來，並可盡力幫助公眾瞭解該項技術。為能提供更優質的醫療服務，我們衷心希望此舉可促使更多有志人士加入新技術的研發隊伍！

值此機會，我謹向香港中文大學於2001年資助第一台手術導航設備的開發致以由衷的感謝。同時，感謝創新科技署資助我們的研究以骨科專業手術機械人的開發；感謝知識轉移處的鼎力支持；感謝我們的企業合作夥伴贊助諸多研究項目及員工培訓教育；特別感謝香港科學館合作籌辦是次別具意義的公共教育展覽。最後，衷心感謝臨床、工程、技術各組的同事為發展香港電腦輔助骨科手術方面所付出的不懈努力。

梁國穗教授
2011.09.10

1. Forewords

It is my pleasure to welcome you to this imperative public education program on how “Technologies enhance patient care”, which is jointly organized by the Department of Orthopedics and Traumatology, Department of Surgery from the Faculty of Medicine together with the Faculty of Engineering, The Chinese University of Hong Kong.

Surgeons are always amazed to observe the advances in technologies which changed the entire practice of surgery. A reflection from a crystal ball still projected images of how surgeons operated daily with a large incision years ago, and how patients were suffered from pain and prolonged recovery. The technological advances in laparoscope, endoscope, energy platforms as well as delicate instruments led to the establishment of minimal access surgery. This concept rapidly gained popularity after the first performance of laparoscopic cholecystectomy in 1987, as smaller wounds induce lesser pain and quicker recovery. Indeed, I would describe the development of minimal access surgery as “a small wound for patient, a big leap for surgery”. Minimal access surgery, however, did not reduce the complexity of the surgical procedure itself. Hence, technological advances became very important to enhance the precision in performing these complex surgical procedures within a confined environment. In this exhibition, we will illustrate how these technological researches and advances have enhanced the performance of complex surgical procedures. This exhibition will also demonstrate the important innovation and technological development from The Chinese University of Hong Kong over the past 20 years, and how these developed technologies could enhance patient care.

I would like to thank the Hong Kong Science Museum for their great contributions and cooperation to make this event a success. I hope you will enjoy the event, and look forward to meeting you at the Hong Kong Science Museum.

Professor Philip WY Chiu
2011.09.10

1. 前言

本人感到非常榮幸，能邀請你們來參加這個別具教育意義的「醫工合作，完美醫療」展覽。本展覽由香港中文大學的矯形外科及創傷學系、外科學系與電子工程學系共同合辦。

外科醫生向來都致力於探索能改善手術操作的先進技術；當神奇的水晶球仍在回顧以往外科醫生每天都在施行大創口手術、患者承受巨大痛楚以及忍受漫長的康復過程等片段時，腹腔鏡、內窺鏡、能源平台，以及精密儀器方面的技術發展，為他們帶來了微創手術的創新概念。由於微小的傷口能減少痛楚及加快康復進度，藉著1987年首次腹腔鏡膽囊切除手術的成功施行，微創手術的概念得到廣泛的關注。事實上，我更願意把微創手術的發展理解為「病人的小創口成就手術的大飛躍」。然而，微創手術並沒有減少手術過程的複雜性；所以，在狹窄的手術室環境下施行複雜的手術，科技的革新成為了提高手術精確度的關鍵。這個展覽將為你解答相關技術的研發是如何讓外科醫生能更有效地施行複雜的手術。另外，這個展覽將為你展示香港中文大學在過去的20年，在微創手術領域的重要創新與技術發展，以及這些技術是如何提升醫療護理的水平。

我很感謝香港科學館為這次展覽所作出的貢獻。最後，希望你們能盡情享受這個科技盛宴，期待與你們於香港科學館相聚。

趙偉仁教授
2011.09.10

2. Sentiments

I am delighted to congratulate the organizing team of this exhibition ：“Technologies enhancing patient care”.

With the advancements in computer and engineering technologies, Computer Assisted Surgery (CAS) has been widely applied in different medical subspecialties in the past decade. The Faculty of Medicine of The Chinese University of Hong Kong has been pioneering different CAS techniques in clinical management and various surgical specialties for improving patient care. The Department of Orthopaedics & Traumatology and the Department of Surgery have been actively implementing various innovative ideas and concepts in CAS research and development since 2001.

The teamwork between clinicians and engineers in this exhibition demonstrates an eminent model of trans-disciplinary collaboration in research and development. Robotic surgery, capsule endoscopy, eagle claw device, and computer assisted navigation orthopaedic procedures required input from clinicians and engineers from design stage to actual implementation and post-operative evaluation. This has been translated into clinical applications. This exhibition is a very good educational event for the general public to learn those new aspects of medical care and how the new technology benefits our patients. In the future, The Chinese University of Hong Kong will continue its dedication and commitment in striving for excellence and new innovations to support the medical and healthcare sectors. Ultimately, the public at large will benefit from these cutting-edge caring technologies.

Professor Joseph Sung
Vice-Chancellor, The Chinese University of Hong Kong
2011. 09. 10

2. 感言

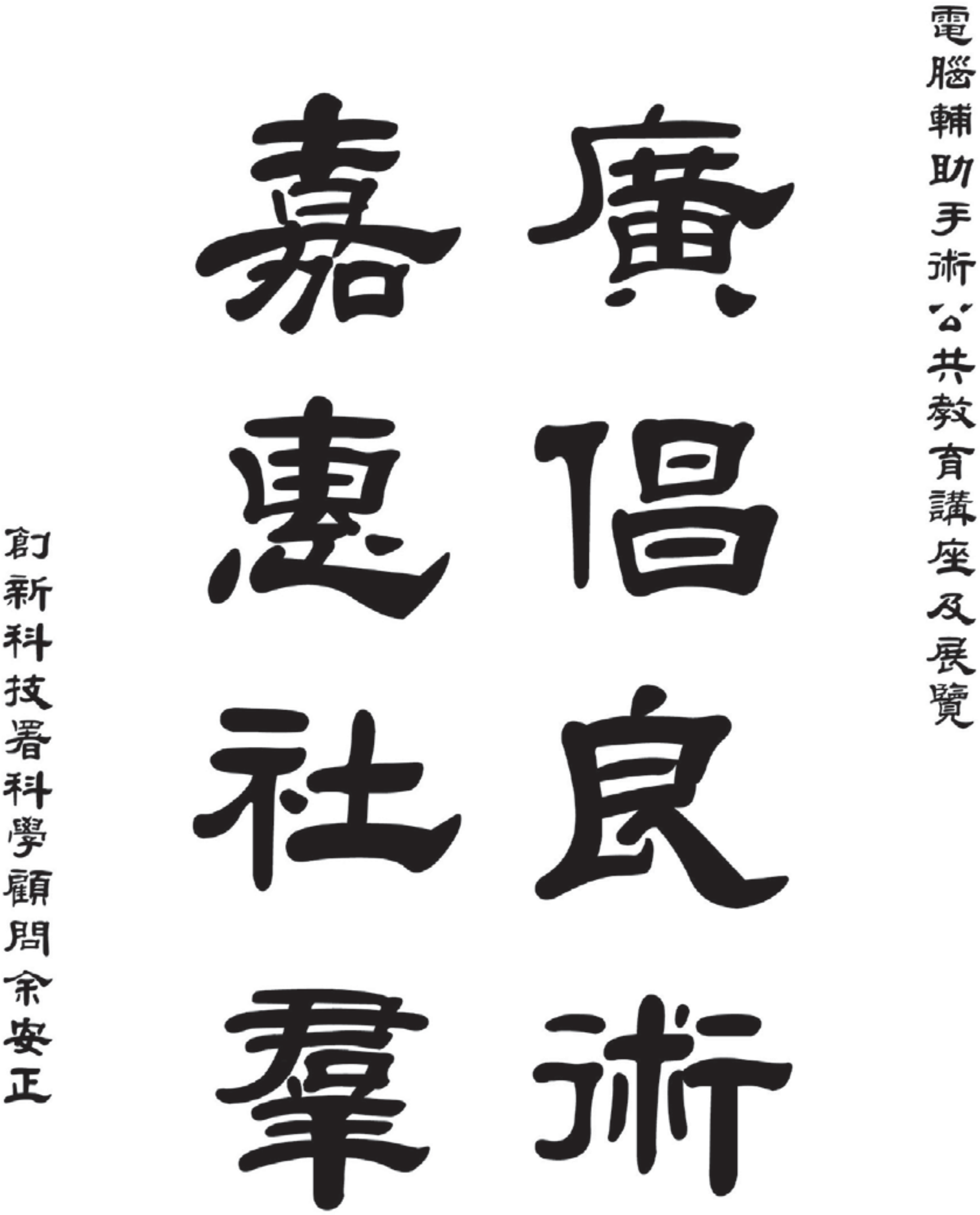
我衷心感謝組織此次活動的所有人員，祝賀他們成功舉辦了「醫工合作，完美醫療」展覽。

隨著電腦及工程技術的發展，電腦輔助手術的技術在過去十年裏，已廣泛應用於不同的醫科領域。香港中文大學醫學院為提升醫護水平，帶領、開拓及研發電腦輔助手術技術在臨床醫療和多種手術專科上的應用。從2001年開始，矯形外科及創傷學系和外科學系，在電腦輔助手術的研發上，積極實踐了多項創新理念。

在是次展覽中，臨床醫生與工程師的緊密合作，充分展示了一個跨學科合作研發的楷模。機械人輔助手術、膠囊內鏡、「鷹爪」內鏡縫合裝置，以及電腦輔助骨科導航手術，從設計、實踐至手術後評估整個過程，都需要臨床醫生和工程師的參與。這些技術目前都已被應用到臨床領域上，為病人提供更好的醫療服務。這次展覽是一個別具教育意義的活動，讓廣大市民能從中認識創新的醫療技術，以及了解這些技術如何幫助患者康復。今後，香港中文大學會繼續信守承諾，致力推動有助醫療保健發展的卓越革新。

香港中文大學校長
沈祖堯教授
2011.09.10

2. Sentiments
感言



電腦輔助手術公共教育講座及展覽

廣倡良術
嘉惠社羣

創新科技署科學顧問余安正

Professor OC Yue
余安正教授
2011.09.10

3. Organizers & Organizing Committee

Organizer:
Department of Orthopaedics & Traumatology, The Chinese University of Hong Kong (CUHK)

Co-organizers:
Department of Surgery, CUHK
Department of Electronic Engineering, CUHK
Hong Kong Science Museum

Programme Leader:
Prof. LEUNG Kwok-sui,
Chair Professor, Department of Orthopaedics & Traumatology, CUHK

Programme Co-leaders:
Prof. CHIU Wai-yan Philip,
Professor, Division of Upper Gastrointestional Surgery, Department of Surgery, CUHK
Prof. CHAN Kam-tai,
Director, Biomedical Engineering Programme, Faculty of Engineering, CUHK

Committee Members:
Dr. TSE Lung-fung,
Honorary Assistant Professor, Department of Orthopaedics & Traumatology, CUHK
Dr. TSO Chi-yin,
Department of Orthopaedics & Traumatology, Prince of Wales Hospital
Mr. TSANG Pak-leung Patrick,
Assistant Computer Officer, Department of Orthopaedics & Traumatology, CUHK
Mr. CHUI Chun-sing Elvis,
Project Assistant, Department of Orthopaedics & Traumatology, CUHK

Secretariats:
Ms. TANG Fung-ngor Cassia,
Project Coordinator, Department of Orthopaedics & Traumatology, CUHK
Ms. TSE Man-sze Mandy,
Project Coordinator, Department of Orthopaedics & Traumatology, CUHK
Ms. CHIN Hang-yi Natalie,
Project Coordinator, Department of Orthopaedics & Traumatology, CUHK

3. 組織機構及籌辦委員會

主辦單位：
香港中文大學矯形外科及創傷學系

合辦單位：
香港中文大學外科學系
香港中文大學電子工程學系
香港科學館

計劃主任：

梁國穗教授	香港中文大學矯形外科及創傷學系

計劃副主任：

趙偉仁教授	香港中文大學外科學系上消化道外科組
陳錦泰教授	香港中文大學電子工程學系

籌委會成員：

謝龍峰醫生	香港中文大學矯形外科及創傷學系
曹知衍醫生	威爾斯親王醫院矯形及創傷外科
曾栢良先生	香港中文大學矯形外科及創傷學系
徐振星先生	香港中文大學矯形外科及創傷學系

秘書組：

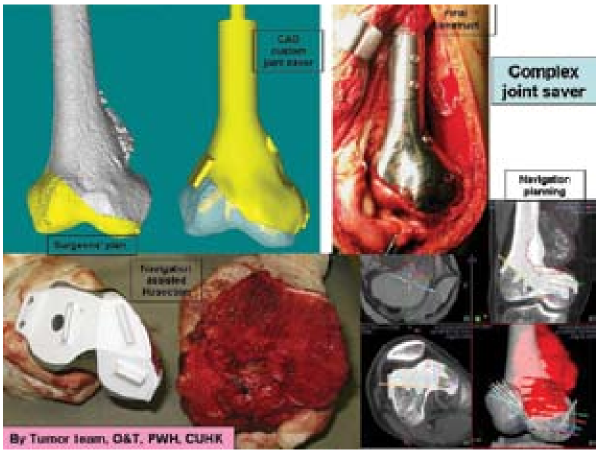
鄧鳳娥小姐	香港中文大學矯形外科及創傷學系
謝文斯小姐	香港中文大學矯形外科及創傷學系
錢幸沂小姐	香港中文大學矯形外科及創傷學系

4. Introduction

With the advancements in computer and engineering technologies, Computer Assisted Surgery (CAS) has been widely applied in different surgical subspecialties in the past decade. The Faculty of Medicine of The Chinese University of Hong Kong has been pioneering different CAS techniques in clinical management and various surgical specialties for better patient care. The Department of Orthopaedics and Traumatology and the Department of Surgery have been actively implementing various innovative ideas and concepts in CAS research and development since 2000. More than hundred scientific publications in CAS have been published in local and international journals.

As a pioneer institute with notable achievement in CAS in the past decade, we would like to organize a series of public education events with open lectures and exhibition to transfer the knowledge related to our research and development works/deliverables in CAS to the general public, in order to convey a positive and informative knowledge to the public. This series of events will also help to show how the demand from the public for better patient care, safer procedures and the increasing requests for minimally invasive procedures are met with research and development in CUHK as well as international professions. This will also draw the public interest on how our developed CAS works could enhance patient care thus supporting further development of the technologies. The event will be co-organized with Hong Kong Science Museum, Leisure and Cultural Services Department, HKSAR.

The Department of Orthopaedics & Traumatology, CUHK developed the first prototype of passive surgical robot which has been used in various orthopaedic surgical procedures with satisfactory clinical outcome. The robot improves the surgical precision and accuracy effectively by minimizing the physical tremor of the hands of surgeons.



Orthopaedic surgeons from the Department of Orthopaedics & Traumatology, CUHK performed the world's first surgical resection and complex joint saving reconstruction after a multi-planar cut of a tumor of the femur using computer assisted navigation technology.

An Eagle Claw

The Department of Surgery, CUHK pioneered the development of first prototype endoscopic suturing device – Eagle Claw. Eagle Claw enables the performance of surgical suturing using the endoscope within the gastrointestinal tract, with a potential application in achieving hemostasis for ulcer bleeding as well as closure of gastrointestinal perforations.

These are some of the examples you will find in our exhibition and public events organised with the Hong Kong Science Museum during September 10, 2011 – March 31, 2012.

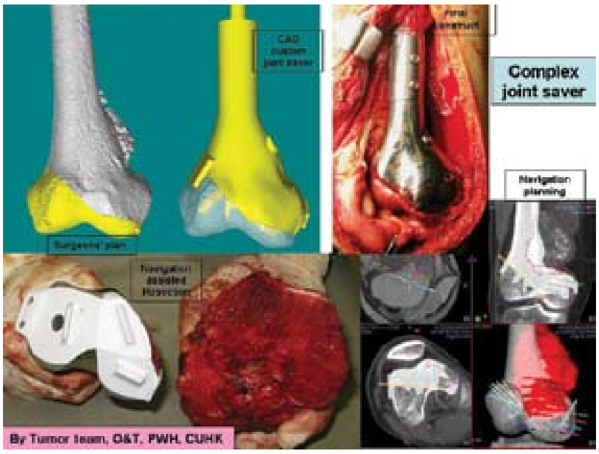
We would like to invite you all to visit and explore.

4. 介紹

過往十年，隨著電腦及工程技術的迅速發展，電腦輔助手術（CAS）已被廣泛應用於外科及骨科各專科領域。為不斷提升醫療水準，香港中文大學醫學院率先在臨床治療及眾多外科專業開展各種CAS技術。自2000年，矯形外科及創傷學系與外科學系致力於CAS方面的研發工作，積極開拓並實踐了大量創新理念，迄今已在本港及國際學術期刊上發表CAS相關論著逾百篇。

鑒於在過往十年中發展CAS成效卓著，作為這領域的先驅機構，我們計畫組織一系列公共教育活動，包括公開講座及展覽，介紹我們在CAS方面的研發工作及成果，以向公眾提供明確及豐富的資訊。當前，人們對醫療技術、操作安全的要求不斷提升，對微創醫療技術的訴求日益增長，故此本活動亦將有助於促進香港中文大學及國際同行的研發工作。同時，本系列活動將引起社會大眾對CAS成果如何提升醫療水準的興趣，從而支持有關技術的發展。此項活動由香港中文大學及康樂及文化事務署轄下的香港科學館聯合舉辦。

香港中文大學矯形外科及創傷學系開發出首台被動式手術機械人原型系統。該系統已於多項手術中成功應用，取得了良好臨床療效。手術機械人的運用可提升外科醫生操作的精準度。



香港中文大學矯形外科及創傷學系的骨科醫生，借助電腦輔助導航技術對股骨腫瘤實施多平面切除，成功完成了全球首例骨腫瘤切除及複雜性關節重建手術。

鷹爪

香港中文大學外科學系率先研製出首部內窺鏡下縫合原型裝置—「鷹爪」。「鷹爪」系統可以借助內視鏡，直視在胃腸道內進行外科縫合術，針對潰瘍性出血的止血，以及胃腸道穿孔的閉合方面，具臨床應用前景。

以上提及的只是是次與香港科學館聯合展出的部分內容，我們誠邀你們前來參觀探討，展期由2011年9月10日至2012年3月31日。

5. Opening Ceremony

Public Education Program on Computer Assisted Surgery with Special Theme on "Technologies Enhancing Patient Care - in the Community"

Opening Ceremony

Date: September 10, 2011

Time: 10:30-11:30

Venue: Science News Corner (SNC), Hong Kong Science Museum

Honorary Guests:

Dr NG C.W. Louis	Assistant Director, The Leisure and Cultural Services Department
Prof SUNG J.Y. Joseph	Vice-Chancellor, CUHK
Mr LEUNG Wing-mo	Assistant Director, Hong Kong Observatory
Prof FOK Tai-fai	Dean, Faculty of Medicine, CUHK
Prof YUE On-ching	Science Advisor, Innovation and Technology Commission, HKSAR
Prof HUNG Leung-kim	Chairman, Department of Orthopaedics and Traumatology, CUHK
Prof LAI B.S. Paul	Chairman, Department of Surgery, CUHK
Prof TSANG Hon-ki	Chairman, Department of Electronic Engineering, CUHK
Prof CHAN Kam-tai	Director of Biomedical Engineering Programme, Faculty of Engineering, CUHK
Ms TAM Sharon	Director, Knowledge Transfer Office, CUHK
Mr. WONG H.L. Michael	Chief Curator, Hong Kong Science Museum

Opening Address by:

Prof SUNG J.Y. Joseph	Vice-Chancellor, CUHK
Prof FOK Tai-fai	Dean, Faculty of Medicine, CUHK
Prof YUE On-ching	Science Advisor, Innovation and Technology Commission, Hong Kong

5. 開幕典禮

電腦輔助手術公共教育講座及展覽
「醫工合作 完美醫療」

開幕典禮

地點：香港科學館科訊廊
日期：2011年9月10日 (星期六)
時間：上午10:30-11:30

主禮嘉賓：

康樂及文化事務署助理署長	吳志華博士
香港中文大學校長	沈祖堯教授
香港天文台助理台長	梁榮武先生
香港中文大學醫學院院長	霍泰輝教授
香港特別行政區政府創新科技署科學顧問	余安正教授
香港中文大學矯形外科及創傷學系系主任	熊良儉教授
香港中文大學外科學系系主任	賴寶山教授
香港中文大學電子工程學系系主任	曾漢奇教授
香港中文大學電子工程學系生物醫學工程學課程主任	陳錦泰教授
香港中文大學知識轉移處處長	譚小蘭女士
香港科學館總館長	黃慶灝先生

開幕致詞：

香港中文大學校長	沈祖堯教授
香港中文大學醫學院院長	霍泰輝教授
香港特別行政區政府創新科技署科學顧問	余安正教授

6. Exhibitions and Talks

Lectures, Lecture Hall, Hong Kong Science Museum

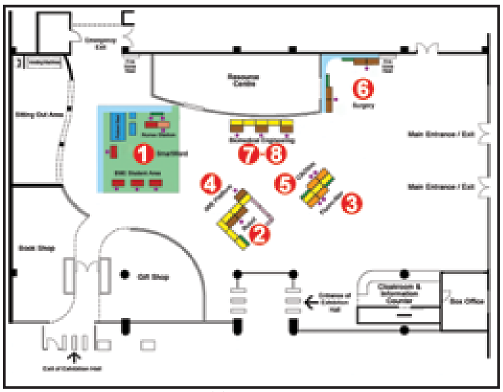
Date: September 10, 2011

Time	Topic	Speaker
11:30-11:55	Bio-Engineering the Human Machine	*Prof Douglas PT Yung* *Dept of Electronic Engineering, CUHK*
11:55-12:20	Computer Assisted Orthopaedic Surgery – Past, Present and the Future	*Prof KS Leung* *Dept of Orthopaedics & Traumatology, CUHK*
12:20-12:45	Development of Upper GI Surgery: from minimal to non-invasive approach	*Prof Philip WY Chiu* *Division of Upper Gastrointestinal Surgery, Dept of Surgery, CUHK*
12:45-13:00	Interactive Discussion	*All speakers and participants*
Lunch break		
14:30-14:55	Robot Assisted Urology Surgery	*Dr Joseph Wong* *Division of Urology, Dept of Surgery, Prince of Wales Hospital*
14:55-15:20	Interactive Weight-bearing Exercise (iWE) Technology – From Research to Application	*Prof Louis WH Cheung* *Dept of Orthopaedics & Traumatology, CUHK*
15:20-15:45	Navigation Assisted Neurosurgery: Brain Tumor Surgery	*Prof George KC Wong* *Division of Neurosurgery, Dept of Surgery, CUHK*
15:45-16:10	Wearable Systems and Their Applications on Cardiovascular Diseases	*Prof Carmen Poon* *Department of Electronic Engineering, CUHK*
16:10-16:25	Interactive Discussion	*All speakers and participants*

Exhibitions at Main Lobby, Hong Kong Science Museum

(Exhibition period: September 10-11, 2011)

1. Smartward Device & Vital Sign Measurements
2. Surgical Robotic Arm
3. Fluoro-navigation in Orthopaedic Trauma Surgery – Clinical Application, Teaching & Training
4. Interactive Weight-bearing Exercise (iWE) Technology – From Research to Application
5. Computer Assisted Surgery Orthopedics Training System - CAOSim
6. Laparoscopic Medical System and Laparoscopic Simulator
7. Smart Home - Wearable Systems for P-Health
8. Assistive Knee Brace

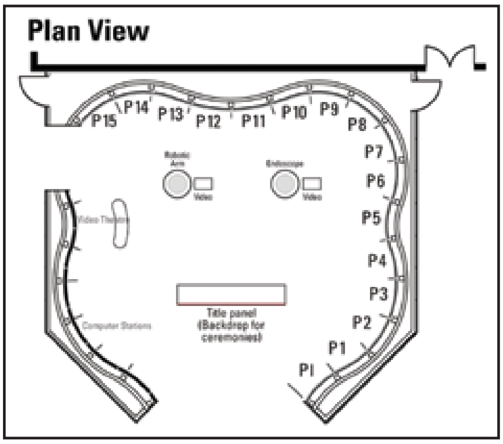


Main Lobby, Hong Kong Science Museum

Exhibition Panels at Science News Corner (SNC), Hong Kong Science Museum

(Exhibition period: September 10, 2011 – March 31, 2012)

PI: Introduction
P1: Smartward – Ward Management System
P2: Smartward – Monitoring and Mobile Devices
P3: Computer Assisted Fracture Surgery
P4: Robot Assisted Orthopaedic Surgery
P5: Computer Assisted Tumor Surgery
P6: Computer Assisted Complex Limb and Spinal Deformity Correction Surgery
P7: Navigation Assisted Sports Surgery
P8: Navigation Assisted Joint Replacement Surgery
P9: Robot Assisted Urology Surgery
P10: Navigation Assisted Neurosurgery: Brain Tumor Surgery
P11: Eagle Claw and Capsule Endoscopy
P12: Smart Home - Wearable MINDS Technologies
P13: Breath Diagnosis
P14: Assistive Knee Brace
P15: CAOS Local Development



SNC, Hong Kong Science Museum

6. 講座及展覽

講座

地點：香港科學館演講廳

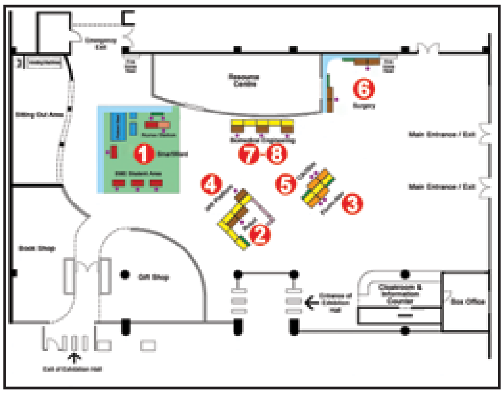
日期：2011年9月10日

時間	題目	講者
11:30-11:55	洞燭生機	榮本道教授 香港中文大學電子工程學系
11:55-12:20	電腦輔助骨科手術—昨天、今天與明天	梁國穗教授 香港中文大學矯形外科及創傷學系
12:20-12:45	上消化道手術的發展：從微創至無創	趙偉仁教授 香港中文大學外科學系上消化道外科組
12:45-13:00	互動交流	所有講者及聽眾
	午膳	
14:30-14:55	機械人輔助泌尿外科手術	黃翰明醫生 威爾斯親王醫院泌尿外科
14:55-15:20	互動負重運動科技—從學術研究到實踐	張穎愷教授 香港中文大學矯形外科及創傷學系
15:20-15:45	導航輔助腦外科手術：腦腫瘤手術	黃國柱教授 香港中文大學外科學系腦外科
15:45-16:10	穿戴式保健系統及其在心血管疾病上的應用	潘頌欣教授 香港中文大學電子工程學系
16:10-16:25	互動交流	所有講者及聽眾

香港科學館大堂展覽

(展覽期：2011年9月10－11日)

1. 智能病房與生命徵象的監測
2. 手術機械臂
3. 透視導航技術在矯形及創傷外科手術中的臨床應用
4. 互動負重運動科技－從學術研究到實踐
5. 電腦輔助骨科手術培訓系統－CAOSim
6. 腹腔鏡手術系統及模擬器
7. 智能家居—穿戴式系統
8. 輔助護膝

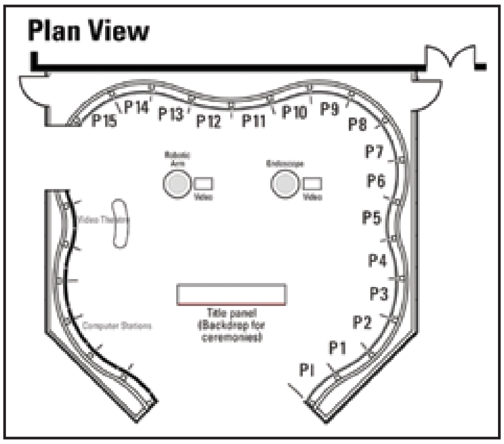


香港科學館大堂

香港科學館科訊廊展覽

(展覽期：2011年9月10日－2012年3月31日)

PI: 介紹
P1: 智能病房－病房管理系統
P2: 智能病房－流動及監測設備
P3: 電腦輔助骨折手術
P4: 機械人輔助骨科手術
P5: 電腦輔助腫瘤手術
P6: 電腦輔助肢體及脊柱畸形矯正手術
P7: 導航輔助運動創傷手術
P8: 導航輔助關節置換手術
P9: 機械人輔助泌尿外科手術
P10: 導航輔助腦外科手術：腦腫瘤手術
P11: 內窺鏡縫合裝置「鷹爪」及膠囊內窺鏡
P12: 智能家居—穿戴式MINDS技術
P13: 呼吸診斷
P14: 輔助護膝
P15: 香港電腦輔助骨科手術進程



香港科學館科訊廊

7. Abstracts of Exhibitions

7.1 Abstracts of Exhibitions at Main Lobby

7.1.1 SmartWard Device & Vital Sign Measurements

SmartWard is an innovative system integrates (i) newly developed net-based software system, (ii) mobile computing platforms and (iii) the application of newly developed and modified monitoring devices, to replace the paper-based process and to facilitate the reporting, tracking, monitoring, diagnosing, fault-avoidance and analysis of patient information in wards to provide high standard patient care efficiently, qualitatively and quantitatively.

SMARTWARD can assist nurses in ward management, and routine and critical patient care by its 5 main subsystems with the impacts on:

1) Reducing human errors in wards and adverse events by providing real time complete and accurate information, especially patient vital signs information, to health care personnel and to remind them of daily activities;

2) Enhancing real time evidence-based decision-making and hence nurses can respond quickly and with the best decisions in actions and treatments to patients. Nurses can be more objective in making decision such as when to inform doctors and when to call for help from junior doctors, senior doctors or even resuscitation team in special situation.

3) Reducing the workload by the system's automation and monitoring features.

4) Facilitating immediate communication of health care personnel from different disciplines to provide the earliest optimal treatment to patients in needs;

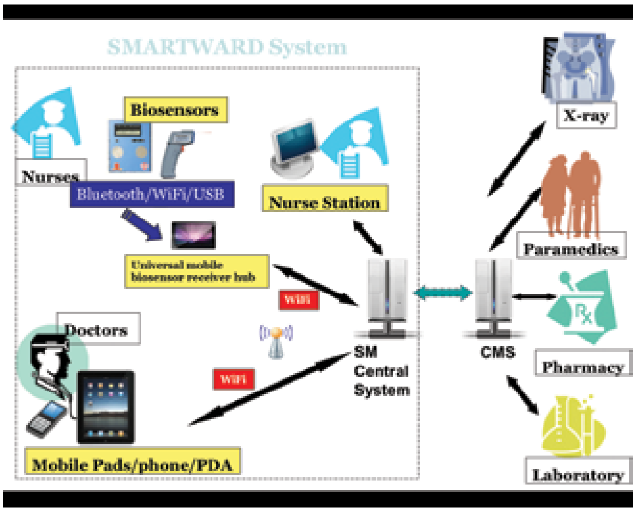
5) Alerting health care personnel to provide immediate attention to individual patient with deteriorating condition as suggested by the real time depiction of the trends and changes in vital signs and symptoms;

6) Enabling efficient management of patient in bed assignments, appointments, pre- and post-operative monitoring and proper allocation of resources in the wards;

7) Streamlining patient care processes by coordinating crucial events from admission to discharge and hence reducing patient's waiting time for diagnosis and treatment; and

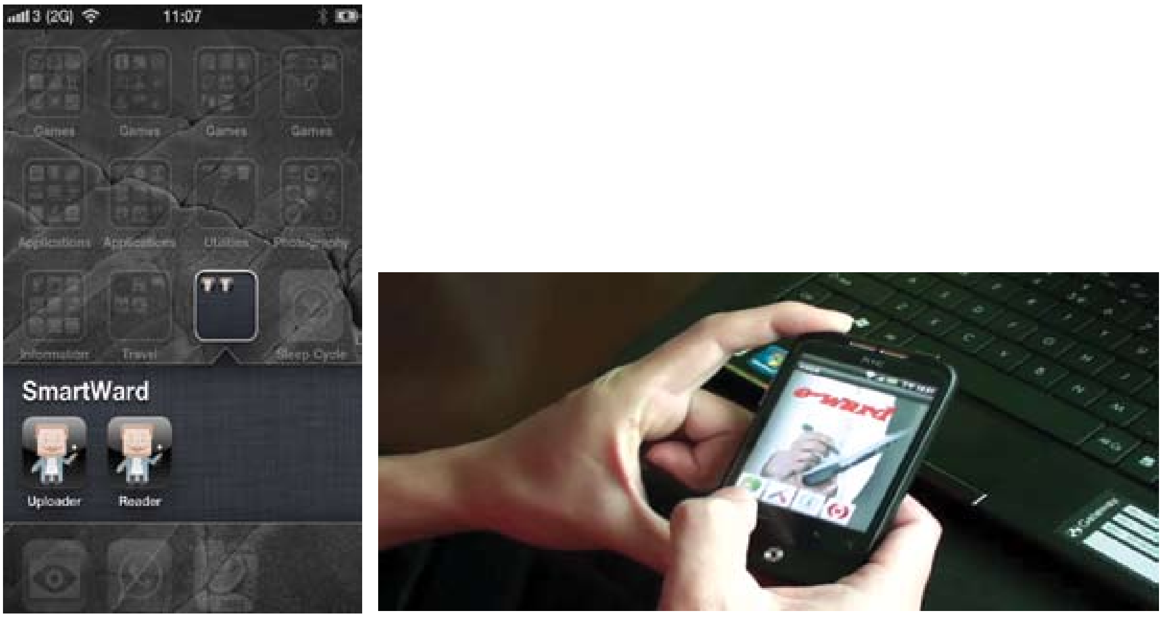
8) Reducing resources and medical cost while providing a comprehensive and accurate database for clinical research and audits.

There are 8 common vital signs which are important to patients including temperature, pulse, blood pressure, oxygen saturation level, input/output of biological fluids, drain, histix and central venous pressure (CVP). In the market, there are biosensors such as electronic thermometer, pressure measurement device and monitoring devices such as intravenous fluid infusion monitor that can be used to measure the vital signs, and some of them are equipped with data port for output. We are going to produce a universal data hub for collecting different kinds of vital signs from different sensors for different brands. RS232, USB, Wi-Fi, and Bluetooth can be used to collect the data from the biosensors. The collected vital sign data are then sent back to the central system through wireless network function of the central hub with encryption.



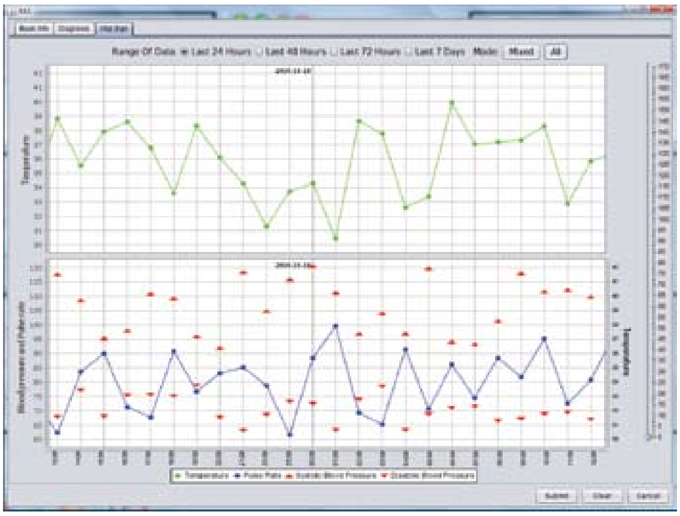
The logical design SmartWard system

Nurse Station in Ward



Mobile Apps Application in different platforms

Prototype of new drip rate measuring device



Vital Sign Monitoring Graphs

7. 展覽摘要

7.1 大堂展覽摘要

7.1.1 智能病房與生命徵象的監測

智能病房是一種創新的系統，綜合多種功能于一身：（1）新研發的基於網絡的軟件系統；（2）移動計算平臺 （3）應用新研發和改良的監控設備。無紙化方式簡化了病房中報告、追蹤、診斷與分析病人信息的程序，減少出錯的幾率，提供高效率和高質量的病人護理服務。

智能病房通過5個子系統協助護士進行病房管理，以及日常和危重病人的護理。其主要影響為：

1) 通過提醒護理人員日常的工作任務，以及向他們提供實時準確的信息，特別是病人的生命體徵信息，減少了病房中人為出錯的幾率。

2) 提升了基於證據的即時決策能力，因此護士能快速作出反應，為病人作出最好的治療。護士在做決定時能更具目的性，例如何時通知醫生，何時向初級醫生、高級醫生，甚至在特殊情況下，向急救隊求救。

3) 借助於系統的自動化和控制功能，減少了工作量。

4) 方便了來自不同學科的醫護人員進行即時通訊，為有需要的病人提供最快最好的治療。

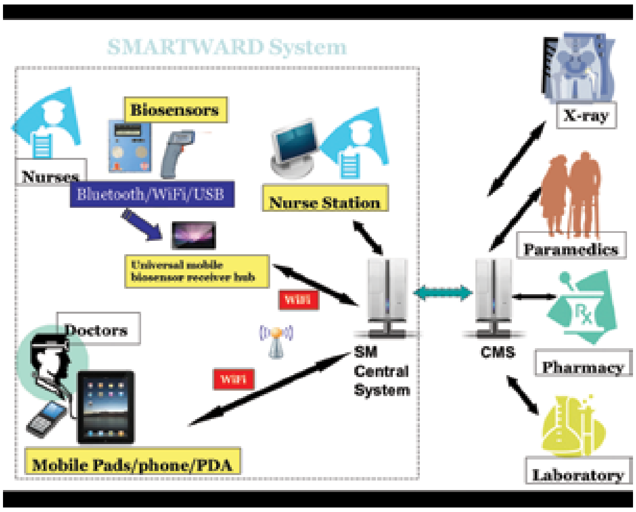
5) 通過生命體徵的趨勢和變化，提醒醫護人員及時關注個別病情惡化的病人。

6) 高效管理病人的住房記錄，手術前和手術后的監控，以及恰當分配病房的資源。

7) 從入院至出院，通過協調重要的事項，簡化病人的護理過程，從而減少病人輪后診斷與治療的時間。

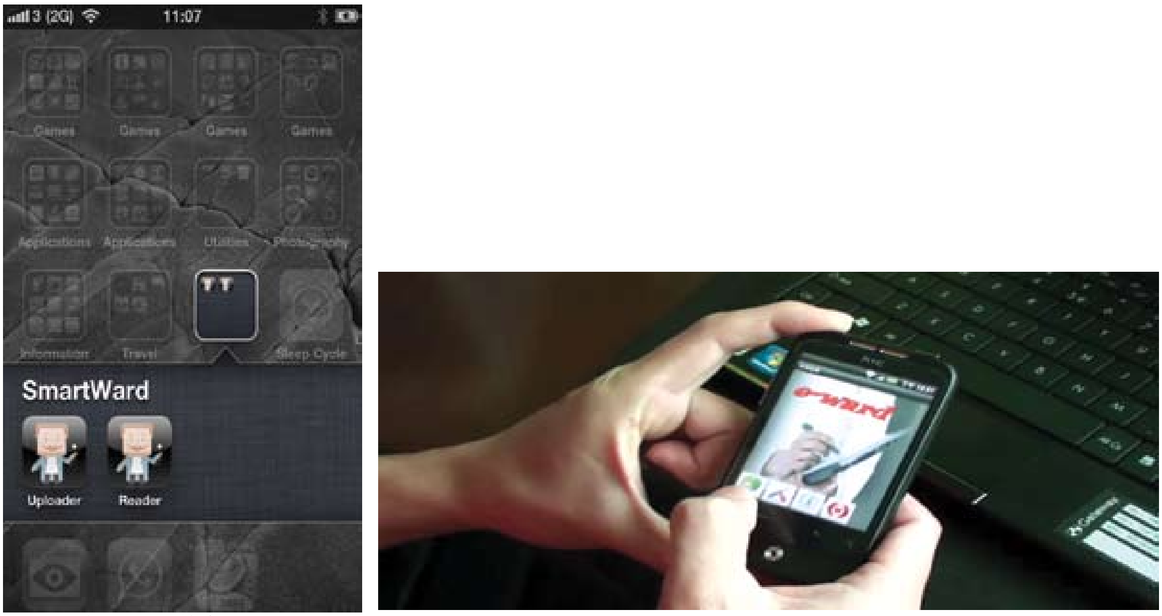
8) 在減少資源及醫療成本的同時，提供全面和準確的數據給臨床研究與審核。

有八個生命體徵對於監測病人身體狀況很重要，包括溫度、脈搏、血壓、血氧飽和度、生物體液的輸入與輸出、排泄、histix和中心靜脈壓（CVP）。在市場上，有如電子溫度計的生物傳感器；壓力測量與監控儀器，如靜脈輸液監控器，可測量生命體徵；有些儀器裝備有數據輸出端口。我們將會建立一個通用的數據中心，用來收集來自多種傳感器的各種生命體徵。RS232、閃存盤、無?網絡以及藍牙可用來採集來自生物傳感器的數據。 收集得到的生命體徵數據，通過具有無?網絡功能的加密的中心樞紐，被傳送回中心系統。



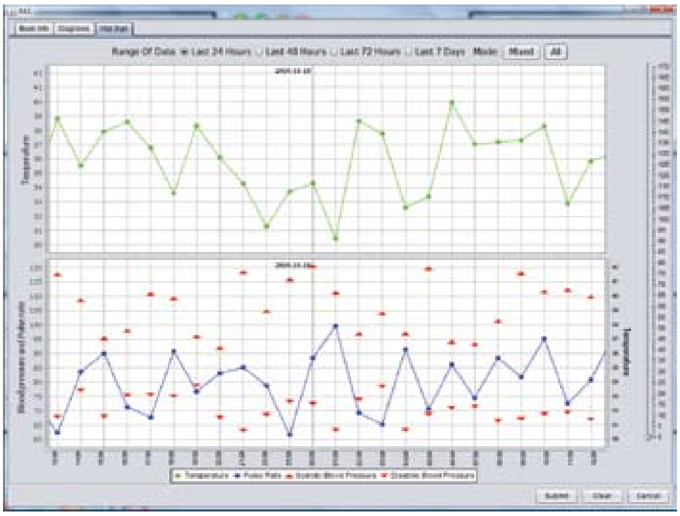
具有邏輯設計的智能病房系統

病房中的護士工作室



各種平臺上的移動應用程序

滴速測量裝置儀器的原型



生命體徵監測圖表

7. Abstracts of Exhibitions

7.1.2 Surgical Robot Arm

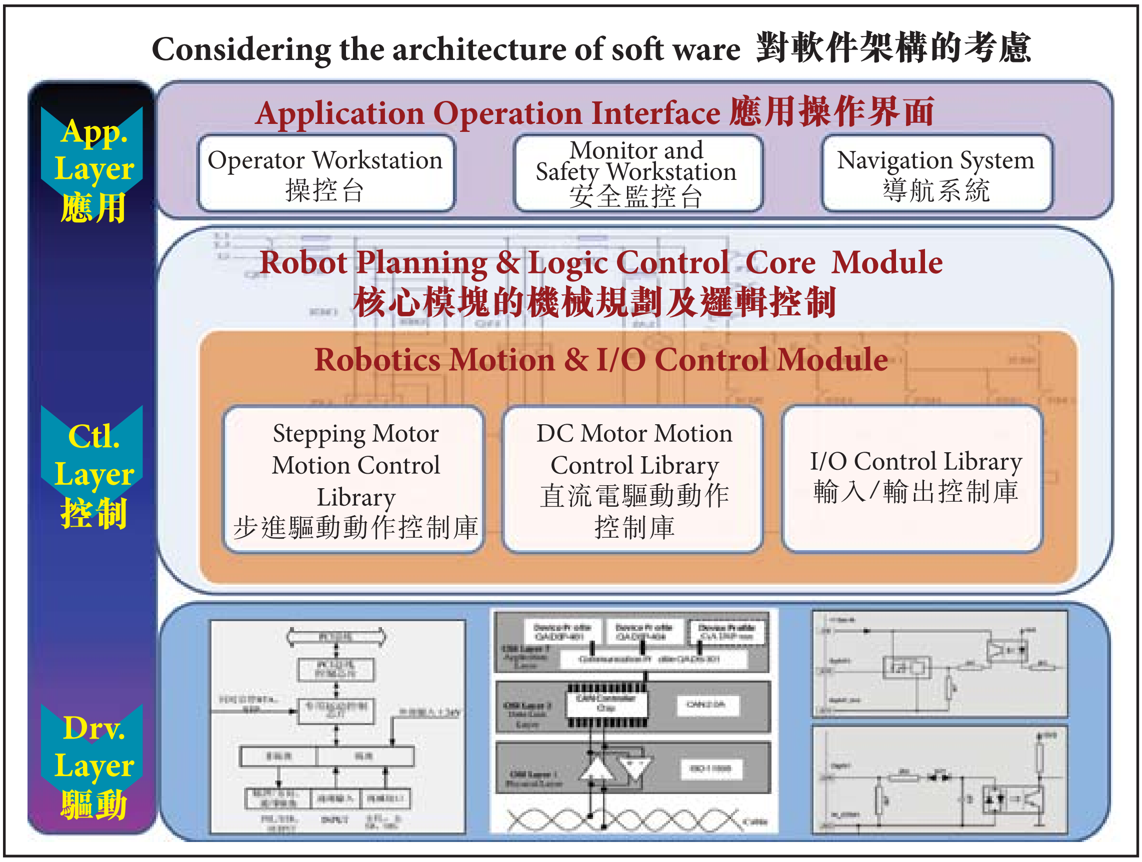
It has been more than 20 years since robotic system was first used in clinical practice. During these years, there has been huge progress in surgical robotics, including theory, technique and clinical applications. Till now, surgical robotics is still one of the most popular fields of biomedical research.

An active-passive hybrid controlled surgical robot is developed by the CUHK and Beihang University, which can be operated both manually and by computer control. The robot has 7 degrees of freedom (DOF) including a prismatic joint, a radial slide joint, and 5 revolute joints. The radial slide joint can fulfill the motion along a fixed curve, and therefore it can bring the robot arm to move around the axis of the human body, which provides suitable work space for surgical applications in the operation room.

This surgical robot can work with surgical navigation system, as it comprises at least one tracking device that emits or reflects infrared signal for surgical navigation system to track its pose.

When the robot is used in surgeries, surgeons can move the robot arm to a rough position near the final position by passive control mode and then let the robot do the fine adjustment to the final position by active control. This active-passive hybrid control can shorten the operation time, minimize the range of auto-motion, increase safety and also ensure the precision and accuracy of the surgical operation.

Therefore, this robot can be used in different orthopaedic surgeries to help surgeons to perform surgical procedures with high precision and predictable clinical outcomes.



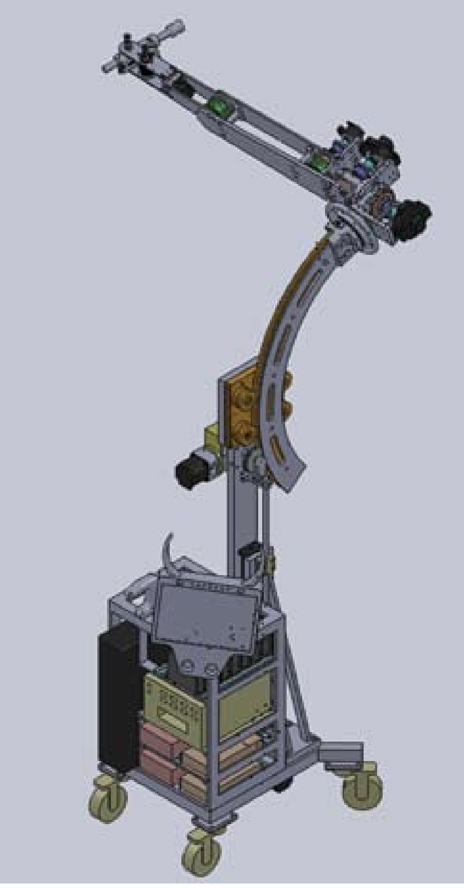
7.1.2 手術機械臂

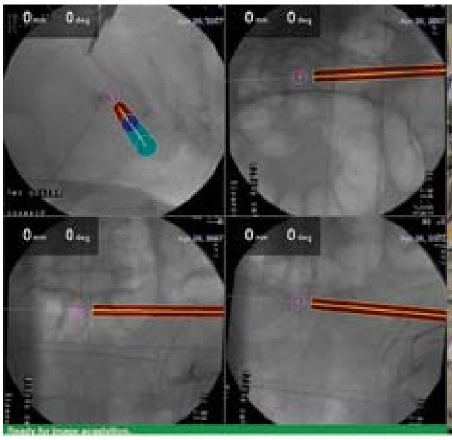
機械人系統用於臨床實踐已有20多年歷史。這些年來，手術機械人理論，技術及臨床應用發展十分迅速。手術機械人研究一直是生物醫學研究領域的熱點之一。

香港中文大學和北京航空航天大學聯合研發出一種主被動混合控制手術機械人。該機械人可由人或電腦控制，具有7自由度，配備一個滑移鉸關節，一個橈側滑動關節，及五個轉動關節。橈側滑動關節能做固定曲線運動，使機械臂圍繞人體做軸線運動，為手術室內進行外科操作提供了足夠空間。
該手術機械人配備有至少一種能發射或反射紅外光的追蹤設備，便於手術導航系統定位，兩者能協同工作。

臨床應用時，外科醫生可利用被動控制系統，先將機械人臂粗略放置到目標位置附近，然後再利用主動控制系統，將其精確放置到目標位置。這種主被動混合控制系統能有效縮短手術時間，減少自移位范圍，保証手術精確度，提高手術操作安全性。

因此，該手術機械人可被用於各種骨科手術，為術者提供極高的手術精確度，使手術達到預期效果。





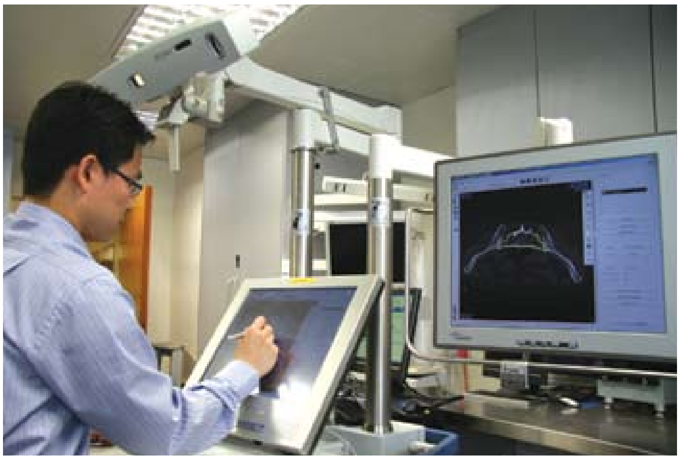
7. Abstracts of Exhibitions

7.1.3 Fluoro-navigation in Orthopaedic Trauma Surgery Clinical Application, Teaching & Training

Computer aided orthopaedic surgery is a recent advancement in surgical technology. Fluoro-navigation is a special technique in orthopaedic trauma surgery where minimally invasive surgery can be carried out with high accuracy of implant fixation. It is an image guided interactive surgical navigation system specially designed for fracture fixation surgeries and other applications where intraoperative fluoroscopic control is required.

As this is a very new technique and requires the interaction between the surgeons, the navigated instruments, the patient's anatomy and the Computer integrated system, it is very important for the surgeons to master the technology and the operative procedures before application in the actual surgery. The Department of Orthopaedics & Traumatology of The Chinese University of Hong Kong have developed a generic system and training models basing on the principles of image based navigation on the standard configuration. By incorporating the fluoroscopic images and the navigation machine, simulated training and practice can thus be possible in the laboratory setting.

The system consists of pre-taken fluoroscopic images of the specific bone model fixed on a specially designed jig. The images stored in the navigation can thus be recalled for practice and training of navigation surgery on the plastic bone without further fluoroscopic images. The trainees thus can carry out the complete surgical procedure of any surgical navigation procedure in the laboratory environment. Objective assessments can also be done on the competency of the surgical procedures before allowing the trainee surgeons to operate in the operating theatres.

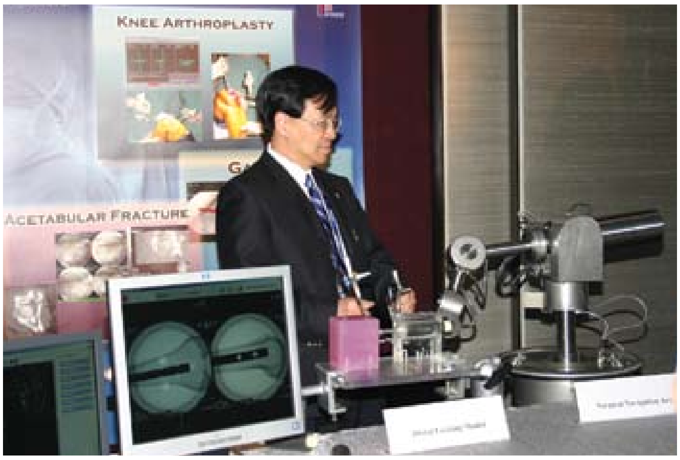


7.1.3 透視導航技術在矯形及創傷外科手術中的臨床應用

電腦輔助骨外科手術，是近年來先進的外科技術。透視導航，是矯形創傷外科的特別技術，讓外科醫生在微創手術中對植入物進行準確定位。透視導航是專為骨折固定手術以及其他需要術中導航的應用而特別設計的影像導向手術導航系統。

由於這是新穎的技術，它需要外科醫生、導航儀、解剖學與電腦集成系統之間的磨合。因此，在真正應用於手術之前，外科醫生對技術和操作步驟的熟練掌握是非常重要的。

在操作前，需要對固定於特製夾具中的特定骨骼模型進行影像透視。這樣，存儲在導航系統中的影像便能被調出，進行塑料骨的手術導航操作與練習，而無需再進行影像透視。因此，實習醫生可以在實驗室環境下，完成需要透視導航的任何外科手術過程。在進入手術室工作前，外科實習醫生的專業技能便可得到客觀的評估。



7. Abstracts of Exhibitions

7.1.4 Interactive Weight-bearing Exercise (iWE) Technology – From Research to Application

iWE Technology®

Fragility fracture is common among Hong Kong elderly, mainly caused by fall and osteoporosis. Fragility fracture not only brings the risk of surgery and long term rehabilitation, but may also lead to other complications and permanent loss of independency. So, the development of iWE technology (vibration treatment) is critical to reduce fall and fragility fracture, by improving muscle strength, balance ability and bone quality.

Our team started the research and successfully developed the unique iWE technology in 2005. The innovative platform design provides highly stable low-magnitude high-frequency vibration stimulation with low power consumption and low maintenance cost. Since 2006, we have been conducting experiments on fractured animals, and clinical trials with in-patients and community elderly.

Results of our research confirmed the effectiveness of iWE in accelerating fracture healing on animals, and indicated that iWE can reduce bone loss, enhance fracture healing and help regaining lower limb functions. A large-scale clinical study on community elderly in 2009 further reinforced the positive efficacy of iWE on enhancing muscle strength, balance ability, and most importantly reducing fall rate of elderly and subsequently improving their quality of life.

Through collaboration with the industrial sector, the first iWE platform was launched to the market in 2010. Up to now, we have provided over 40 iWE platforms in more than 20 local community centers, serving over 1500 elderly.

第一代原型（動物）
First prototype (animal)

第二代原型（動物）
Second prototype (animal)

第三代原型
Third prototype

7. 展覽摘要

7.1.4 互動負重運動科技 — 從學術研究到實踐

骨質疏鬆症和跌倒引致的脆性骨折，是香港常見的長者問題。脆性骨折除了帶來手術的風險和漫長的復康外，亦有機會引至其他併發症及喪失活動能力。所以我們致力研究透過互動負重運動改善肌力、平衡力及骨質密度，從而減少跌倒及骨折的危機。

我們於2005年開展有關科研，並成功研發出獨有的互動負重運動儀，提供高頻率及低幅度的高效振動刺激，同時達致低磨損及低耗電的設計。我們的動物測試及臨床研究證實互動負重運動能有效減慢骨質流失，使骨折癒合時間縮短，提升下肢活動能力，令復康情況更為理想。我們在2009年展開了更大規模的臨床研究，初步結果顯示互動負重運動能有效提升平衡力、肌力，及減低跌倒次數，最重要是可改善長者的生活質素。

透過與工業界的合作， 我們於2010年將互動負重運動儀正式推出市場。現時，我們共提供超過四十台互動負重運動儀於本港二十多間社區中心，為超過一千五百名長者提供服務及作研究用途。

第四代原型
Fourth prototype

第五代原型
Fifth prototype

iWE運動儀（市場版）
iWE Platform (marketing version)

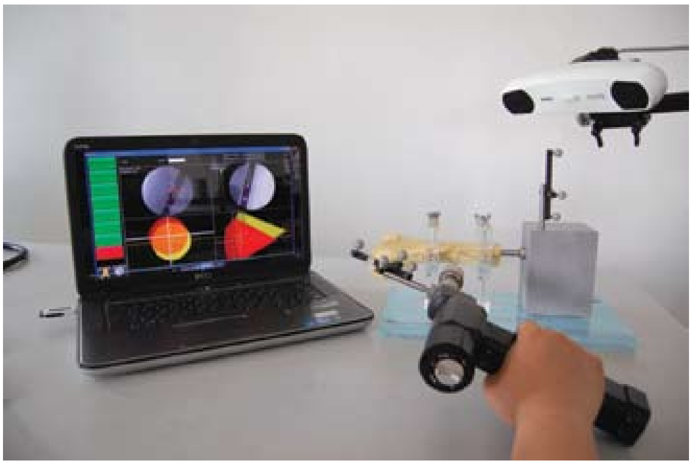
7. Abstracts of Exhibitions

7.1.5 Computer Assisted Surgery Orthopedics Training System - CAOSim

CAOSim is the first comprehensive computer assisted surgery orthopedics training system in the world. It uses the world leading tracking technology from NDI and gets US patented design by The Chinese University of Hong Kong. This system is a commercialized product of the cooperation between the University and the industrial company, Digital Wave, via the process of academic, research, production and application.

The system consists of four models, including Distal Locking, Proximal Femur Fracture Fixation, Percutaneous Screw Fixation for Acetabular Fracture and Iliac-sacral Screw Fixation.

The system can be used without limited practicing opportunities in the laboratory. It simulates real time visual feedback, real time accurate force sensing and real time clinical approaches with standard surgical tools. It effectively cuts down the operation time, reduces x-ray exposure, and significantly increases the procedure accuracy.



Distal Locking Practice Model

Demonstration of CAOSim

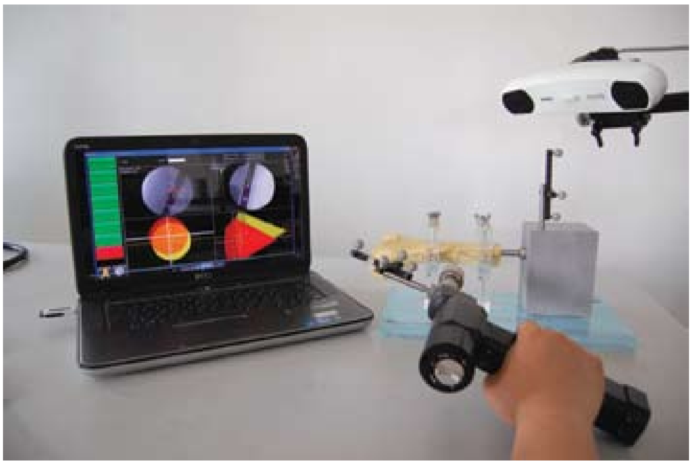
7. 展覽摘要

7.1.5 電腦輔助骨科手術培訓系統－CAOSim

CAOSim是國際首套電腦輔助骨科手術培訓系統。它採用最先進的NDI定位跟蹤設備，並獲得了美國實用新型培訓模型專利。該系統是香港中文大學與工業界的「集翔多維」， 透過「學研產用」過程， 從理論發展到商品的合作成果。

該系統一共包括四款模型，交鎖髓內釘遠端鎖定、股骨近端骨折固定、經皮螺釘固定髖臼骨折和骶髂骨內固定。

該系統採用真實的手術工具，模擬真實的導航手術過程，給培訓者真實的力覺回饋。通過培訓，不僅縮短了醫治時間，減少X光照射，而且提高了手術精度。



交鎖髓內釘遠端鎖定模型

CAOSim系統示範

7. Abstracts of Exhibitions

7.1.6 Surgical Laparoscopic Simulator

There has been a tremendous development in endoscopy over the past decades. Bleeding peptic ulcers was largely managed by surgical resection 30 years ago which led to significant morbidities and mortality. With the advances in therapeutic endoscopy, endoscopy became the primary method of hemostasis for these ulcers. The discovery of Helicobacter pylori, eradication therapy subsequently reduced the incidence of bleeding peptic ulcer. However despite these advances, there was still a significant risk of ulcer rebleeding which could lead to need of surgery and mortality.

The current methods of endoscopic therapy are limited by the size of the bleeding vessel that hemostasis can be achieved. If the bleeding vessel is larger than 2mm, surgical plication with sutures achieved the best hemostasis. The concept of endoscopic suturing device was first proposed by Professor Sydney Chung. The prototype endoscopic suturing device, named Eagle Claw was first constructed in collaboration with a Japanese company. After several modifications, we tested the Eagle Claw VII in the efficacy of achieving endoscopic hemostasis in an animal model. Eagle Claw was found to be very effective in achieving hemostasis for massively bleeding gastric ulcer, which part of the gastroepiploic vessel was implanted into the stomach to simulate the torrential bleeding.

With the concept of natural orifices transluminal endoscopic surgery, endoscopic suturing device became very important for closure of GI luminal access. We examined the feasibility of closing the gastric wall access in animal model. In 10 porcine models, Eagle Claw was found to be safe and effective in closing the gastric opening with an average of 3 stitches. Eagle Claw is now modified into another device named Apollo Overstitch, and a clinical trial will soon be conducted to test the efficacy of overstitch in achieving hemostasis for bleeding peptic ulcers.

Figure 1 – Eagle Claw VII 第七代鷹爪

7.1.6 腹腔鏡手術模擬器

在過去的幾十年裏，內鏡技術得到了巨大的發展。30年前，對出血消化性潰瘍的治療是通過手術切除，但會導致嚴重的發病率及死亡率。隨著治療性內鏡技術的發展，內鏡技術成為了消化性潰瘍的主要止血方法。進行根治幽門螺旋杆菌的治療，能減少出血的消化性潰瘍的復發率。然而，儘管取得了這些進展，但仍存在再出血的風險，需要進行手術，嚴重的會導致死亡。

目前的內鏡治療受限於止血工具可接觸到的出血血管的大小，如果出血血管大於2毫米，則能達到最好的止血效果。鍾尚志教授首先提出內鏡縫合裝置的概念。內鏡縫合裝置的雛形，命名為鷹爪，是與一間日本公司合作研發的。經過多次改良，我們在一個動物模型上測試了第七代鷹爪的內視止血功效。實驗證明，鷹爪對於大量出血的消化性潰瘍具有很好的止血效果。

隨著孔腔內鏡外科手術的發展，內鏡縫合裝置，在胃腸道空腔的封閉過程中變得越來越重要。我們在一個動物模型上測試了內鏡縫合裝置封閉胃壁的可行性，在10個豬模型中，我們證明了鷹爪能安全有效地封閉平均有3個拆線的胃部創口。鷹爪現在被改良為另一名為Apollo Overstitch 的產品，並將對其處理出血消化性潰瘍的有效性進行臨床試驗。

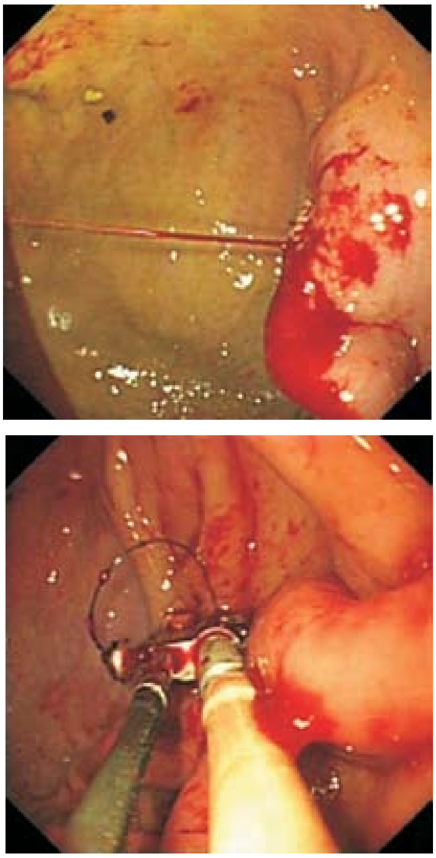


Figure 2 – Plication of massively bleeding ulcer with Eagle Claw
鷹爪對大量出血性潰瘍進行縫合

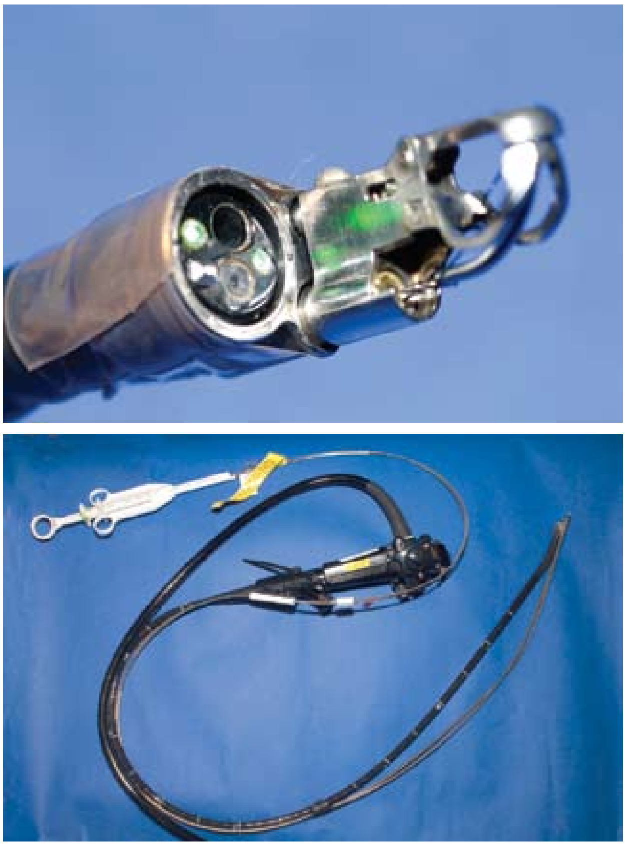


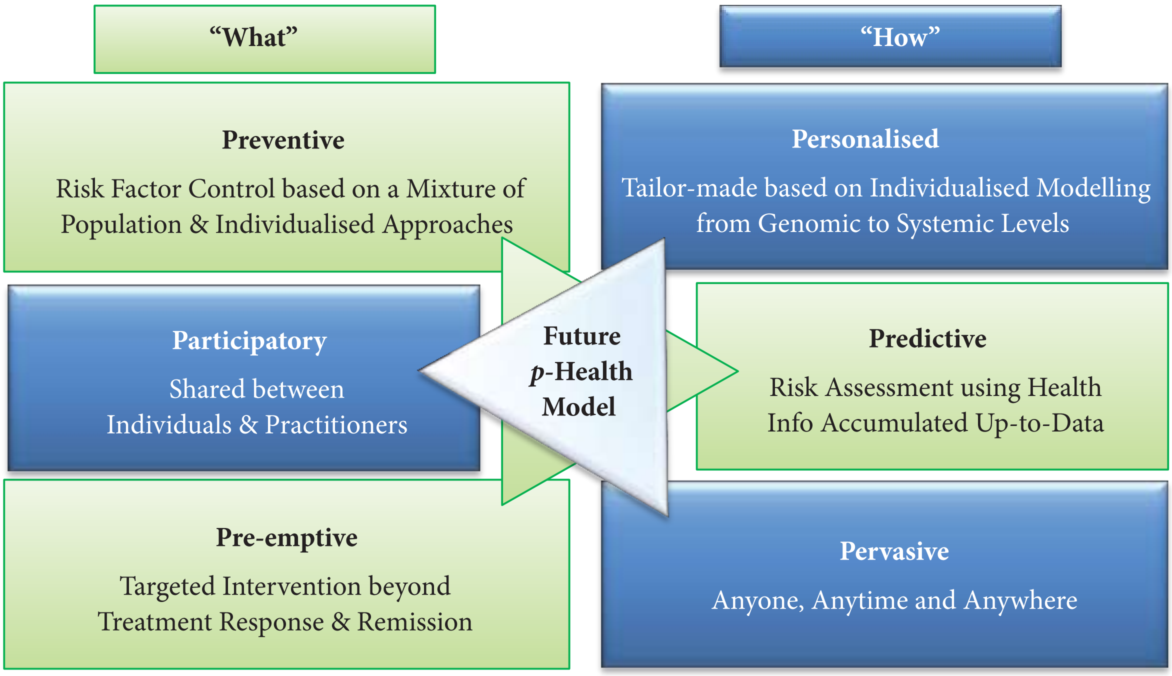
Figure 3 – Eagle Claw VIII
第八代鷹爪

7. Abstracts of Exhibitions

7.1.7 Smart Home - Wearable Systems for P-Health

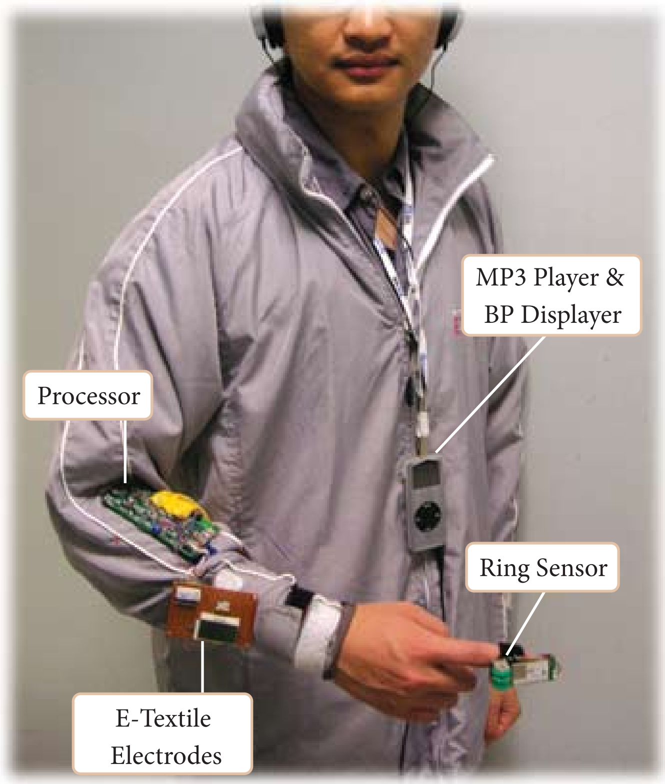
Driven by the increasingly aging population, prevalence of chronic diseases, skyrocketing health costs and higher healthcare expectations, there is a pressing need to shift the conventional hospital-centred medical model towards a ***p***-Health paradigm, i.e. a 6-P's model emphasising the adoption of ***personalised*** diagnosis and treatment, ***participatory*** decision-making as well as ***pervasive*** health services and technologies for the ***prevention*** of diseases via ***predicting*** how, when, and in whom a disease will be developed and subsequently applying ***pre-emptive*** treatments before it occurs.

p-Health paradigm is crucial for dealing with health issues such as sudden cardiovascular (CV) deaths. CV disease, despite the enormous efforts dedicated to prevent it in the past years, has remained the primary cause of mortality in most countries. New strategies are thus urgently needed to effectively identify asymptomatic patients who are at high-risk of acute CV deaths. Acute CV events are believed to be resulted from the interaction between a substrate, i.e. the development of vulnerable plaques during atherosclerosis, and a trigger that leads to the final dynamic event, i.e. the rupture of the vulnerable plaque. While the presence of vulnerable plaques have to be better identified by new multi-modal imaging, blood test and genetic markers, near-term prediction of the occurrence of the final dynamic event will require information supplied from wearable systems.



The future p-Health model, i.e. the 6-P's paradigm, is formed by two triangles that describe respectively *'what kind of health decisions should be made' and 'how health decisions should be made'.*

Ref: Y.T. Zhang & C.C.Y. Poon, IEEE Trans. on Information Technology in Biomedicine, 14(3):543-5, 2010; Proposed based on U.S. NIH 4-P's paradigm.



A health-shirt (h-Shirt) for continuous monitoring of multiple cardiovascular parameters, with possible real-time active bio-feedback mechanisms.

Ref: C.H. Chan, C.C.Y. Poon, R.C.S. Wong and Y.T. Zhang, in Proc. 4th IEEE-EMBS Int. Summer School and Sym. on Medical Devices and Biosensors, Cambridge, U.K., 19-22 Aug, 2007, pp. 121-123.

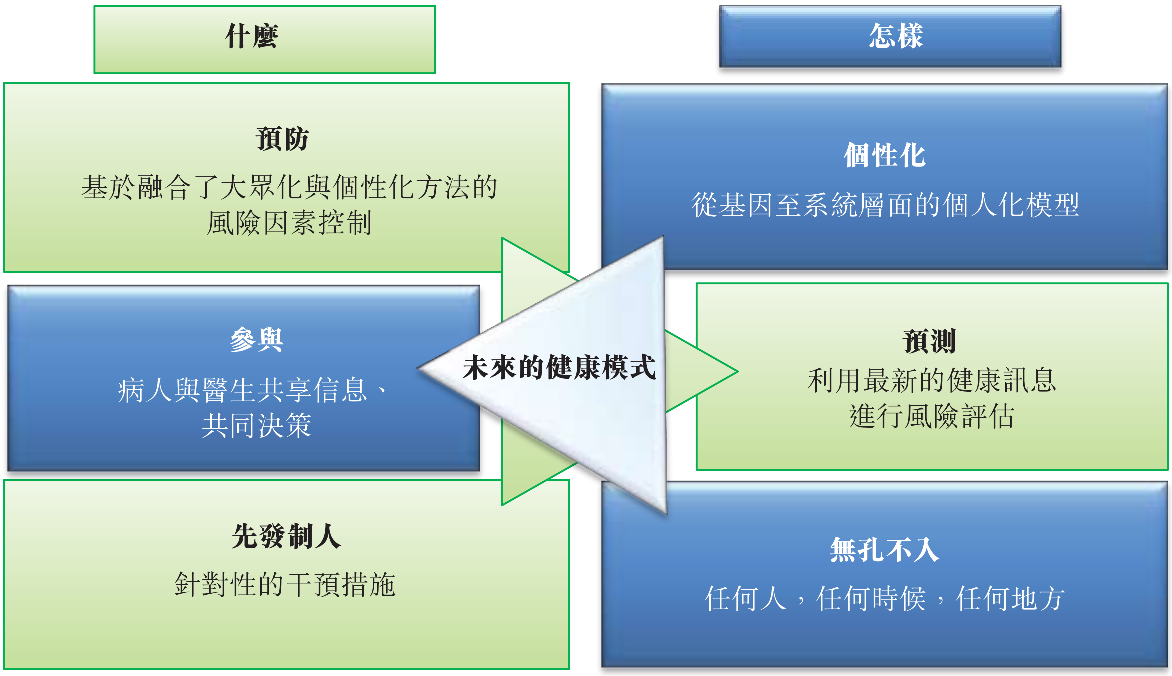
Wireless wearable systems for remote diagnosis and display for multiple physiological signals and parameters.

Ref: 1) W.B. Gu, C.C.Y. Poon, et al., “A h-Shirt-Based …,” in BSN 2009, Berkeley, USA.
2) Y.T. Zhang, C.C.Y. Poon, et al., “A health-shirt using e-textile …,” in MDBS 2006, MIT, USA.

7.1.7 智能家居—穿戴式系統

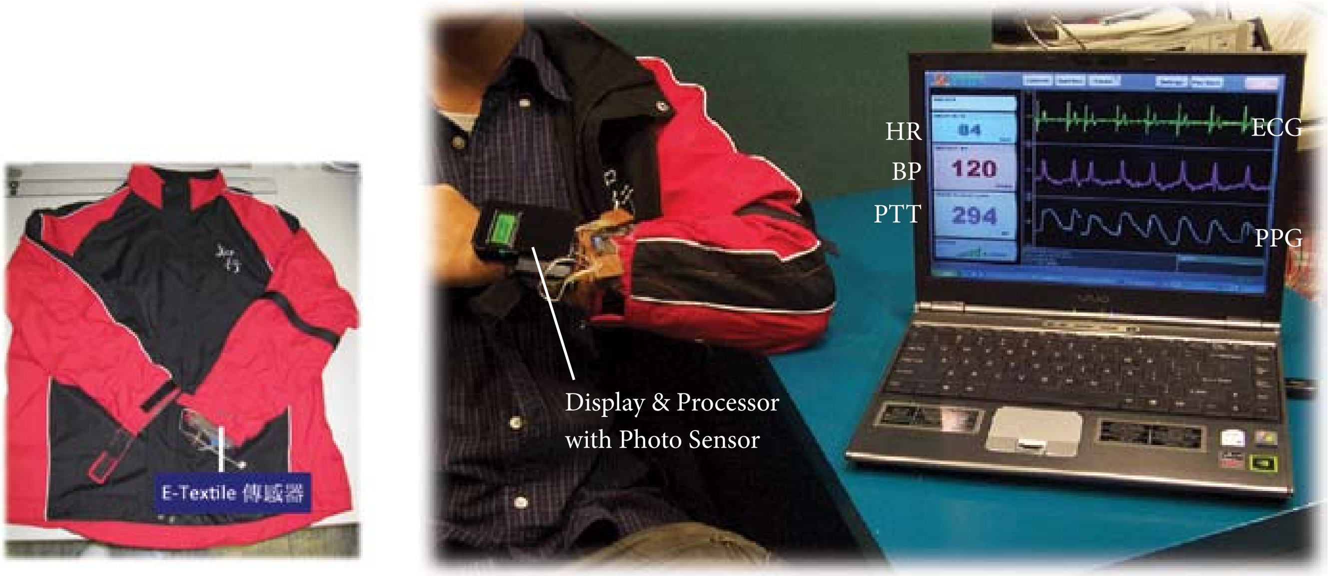
隨著人口老年化的加劇、罹患慢性疾病的人數增多、醫療成本的增加以及人們對醫療保健的更高期望，傳統以醫院為中心的醫療模式正轉向一個6-P的“p-健康”模式，即強調個體性(Personalized)的診斷和治療、普及性(Pervasive)的健康服務和技術、參與性的醫療決策制定(Participatory)、並通過預測(Predict)何時何人將發生什麼樣的疾病，在病發前提供先發性(Pre-emptive)的治療，以達到疾病預防(Prevention)的目的。

預測健康模式對於處理健康問題至關重要，例如因突發性心血管疾病而死亡。儘管在過去幾年裏，大部分國家為預防心血管疾病付出了巨大努力，但它仍然是導致死亡的首要原因，因此極需能夠從無症狀病人中有效地篩選急性心血管死亡事件高危人群的新策略。急性心血管問題相信是動脈在粥樣硬化中出現的易損斑塊破裂引起。然而，要檢測易損斑塊的出現，必須借助於新型的多模態造影技術、血液測試與遺傳標記，以及近期對最終運動情況的預測，這都需要由可穿戴式保健系統提供的數據作為支持。



將來的個人化保健系統模式，例如“6-P”範例，是由兩個分別描述的三角形組成“採取哪种保健決策”與“怎樣執行保健決策”。

一件保健衣能連續監控多種心血管的參數，這些參數具有實時有效的生物反饋機制。



能移動診斷與顯示多種生理信號和數据的無線可穿戴式系統。

7.1.8 Assistive Knee Brace

Assistive knee braces are a kind of wearable lower extremity exoskeletons that can enhance people's strength and provide desired locomotion. It is possible to use knee braces to assist elderly or disabled people on improving their mobility in order to solve many daily life problems, such as going up and down stairs and crossing over obstacles. With a continually aging world population, devices that help elderly with mobility problems are in great need. By using assistive knee braces, patients may avoid being bedridden and will be able to maintain their physical activities. They will be able to benefit from the positive effects of exercise and enjoy an active lifestyle.

In our research, the assistive knee brace was developed by integrating a multifunctional actuator with a custom-made knee-ankle-foot orthosis. The multifunctional actuator is a novel actuator to integrate the advantages of electric motor and magneto-rheological fluids while decreasing the dimension.

This work was supported by a grant from the Innovation and Technology Commission of the Hong Kong Special Administrative Region, China (Project No. ITS/308/09).

7.1.8 輔助護膝

輔助護膝，是一種可穿戴的下肢外生骨骼。它能增強人體的力量，協助實現自主行走。輔助護膝通過提高老年人與殘疾人士的運動機能，幫助他們解決許多日常生活的問題，譬如上落樓梯，以及跨越障礙物。隨著世界人口不斷老化，老年人對那些能提高他們運動機能的機器，有很大的需求。另外，通過使用輔助護膝，病人可避免長期臥床，從而維持運動機能，享受積極的生活模式。

我們研發的輔助護膝，是一種具有膝足矯形器的多功能驅動裝置。它具有馬達與磁流變流體的優點，同時降低了維度。

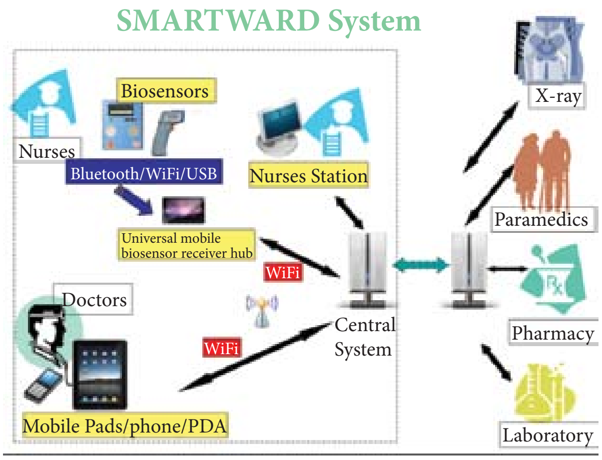
這項研究得到了香港特別行政區創新科技署的資助（項目編號：ITS/308/09）。

7. Abstracts of Exhibitions

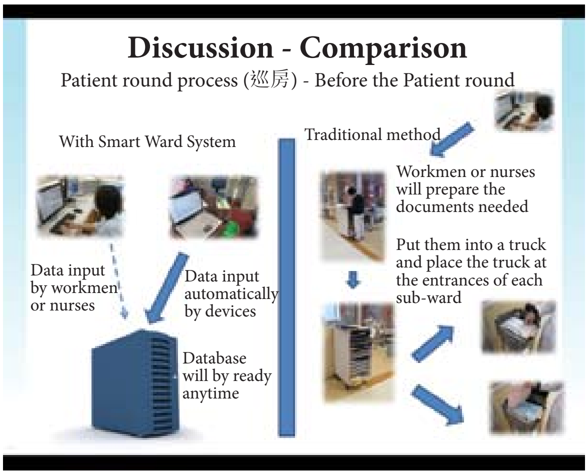
7.2 Abstracts of Exhibition Panels at Science News Corner

Panel 1: SmartWard – Ward Management System

SmartWard is a web-based application running on mobile computing platform together with the integration of biosensor, alarm system, position tracking system, etc, to replace the paper-based process and to facilitate the reporting, tracking, diagnosis and analysis of patient information in wards to provide better patient care.



Nurse Station in Ward



Discussion - Comparison

Patient round process (巡房) - Before the Patient round

With Smart Ward System

Data input by workmen or nurses

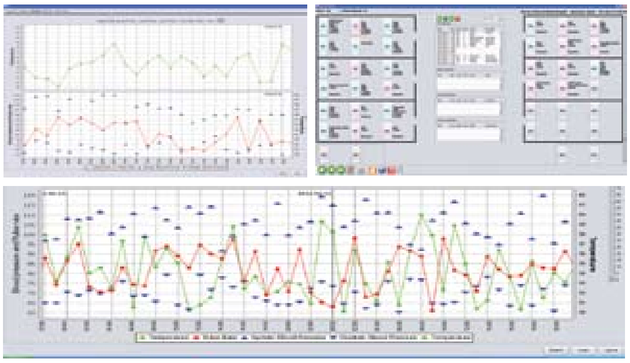
Data input automatically by devices

Database will by ready anytime

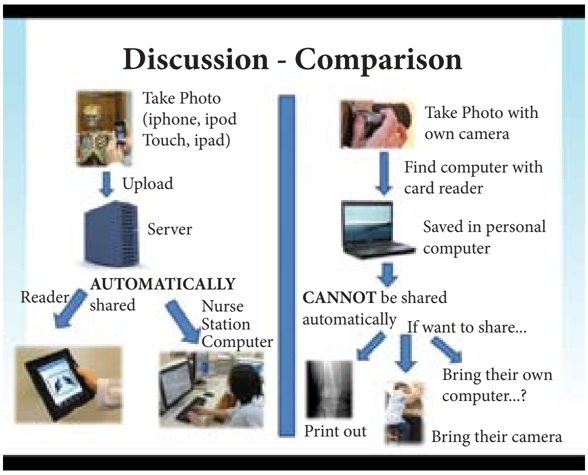
Traditional method

Workmen or nurses will prepare the documents needed

Put them into a truck and place the truck at the entrances of each sub-ward



Real time vital signs monitoring data



Discussion - Comparison

Take Photo (iphone, ipod Touch, ipad)

Upload

Server

AUTOMATICALLY shared

Reader

Nurse Station Computer

Take Photo with own camera

Find computer with card reader

Saved in personal computer

CANNOT be shared automatically

If want to share...

Print out

Bring their own computer...?

Bring their camera

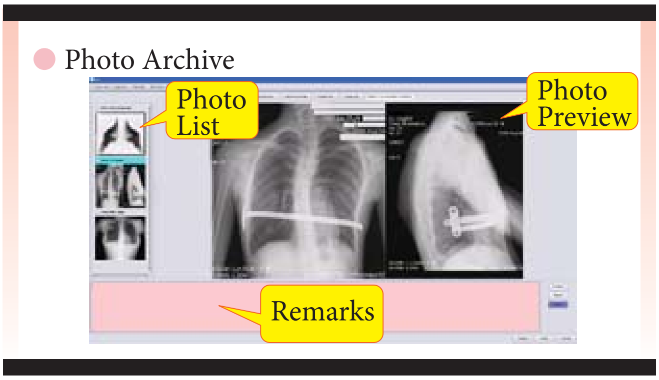


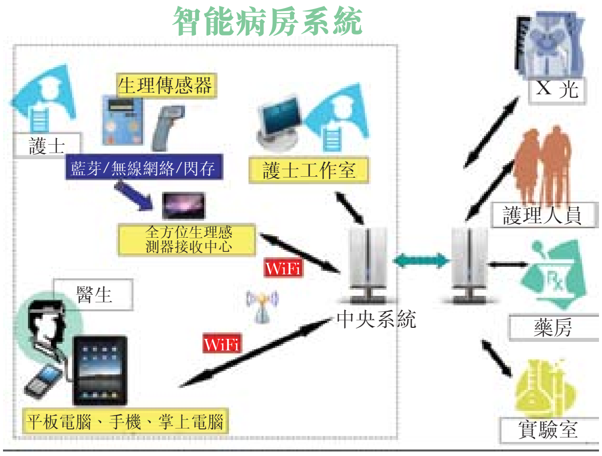
Photo Archive

7. 展覽摘要

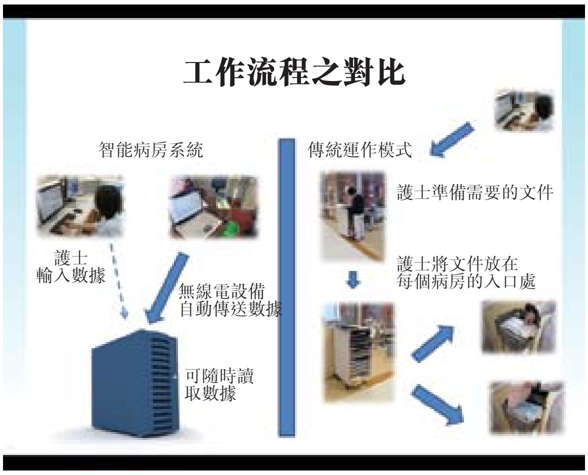
7.2 科訊廊展覽摘要

P1: 智能病房－病房管理系統

『智能病房』項目，以基於網路的應用技術基礎，配合生理感測器、 預警系統、病人定位系統等，構建而成的應用系統，使用流動電腦處理技術平臺，替代傳統以紙張紀錄方式記錄病歷。為病房提供簡便而全面的電子化病人資訊查詢、診斷和分析。值此提供更好的病人護理服務。



護士工作室



工作流程之對比

智能病房系統

護士
輸入數據

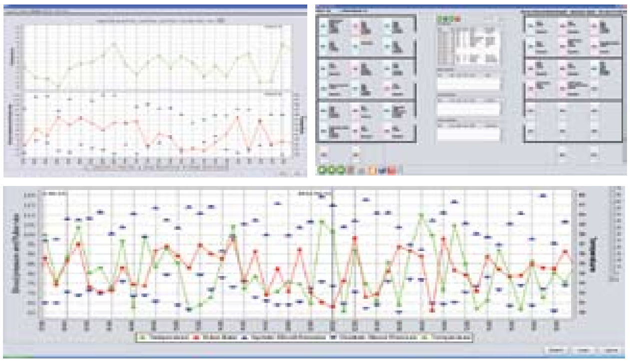
無線電設備
自動傳送數據

可隨時讀取數據

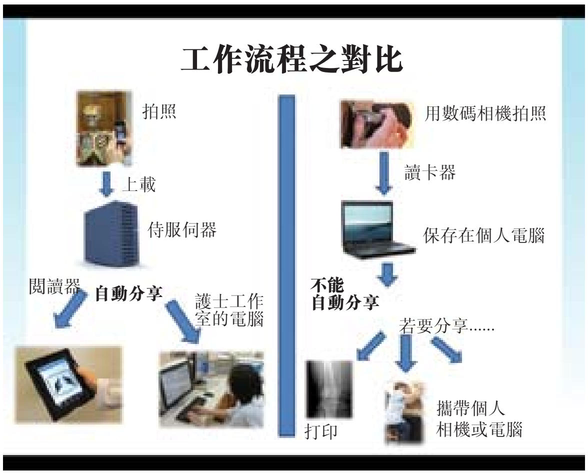
傳統運作模式

護士準備需要的文件

護士將文件放在
每個病房的入口處



實時監測生命體徵之數據



工作流程之對比

拍照

上載

侍服伺器

閱讀器

自動分享

護士工作
室的電腦

用數碼相機拍照

讀卡器

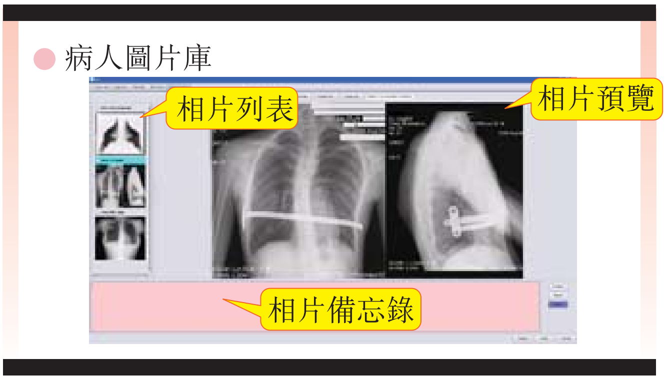
保存在個人電腦

不能
自動分享

若要分享......

打印

攜帶個人
相機或電腦



● 病人圖片庫

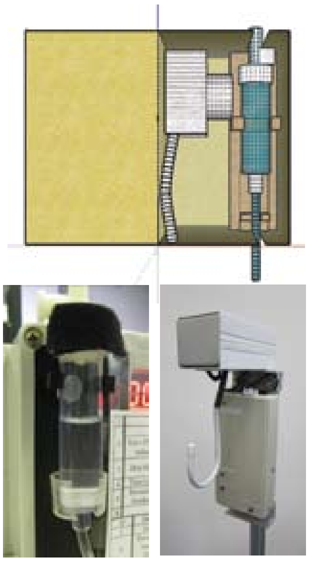
7. Abstracts of Exhibitions

7.2 Abstracts of Exhibition Panels at Science News Corner
Panel 2: SmartWard – Monitoring and Mobile Devices

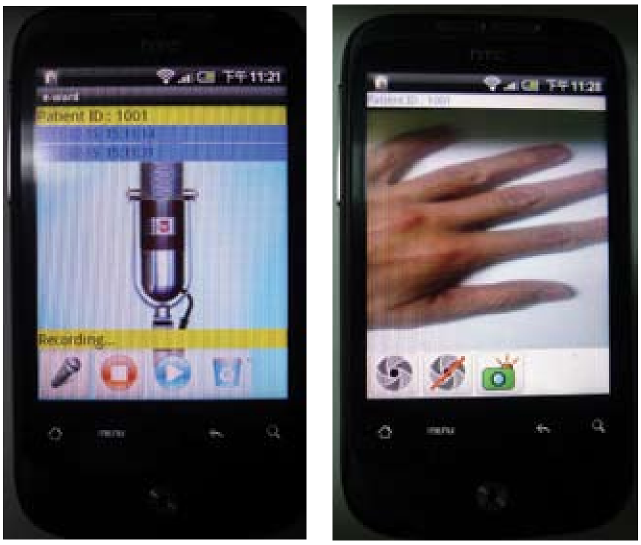
There are eight common important vital signs to patients including temperature, pulse, blood pressure, oxygen saturation level, input/output of biological fluids, drain, histix and Central venous pressure (CVP).

Our CUHK Biomedical Medical Engineering students have invented different kinds of vital signs monitoring devices for collecting patient data which are then sent to the central system through wireless network function of the central hub and mobile devices with encryption.

Blood pressure and heart rate measuring devices with wireless transmission function



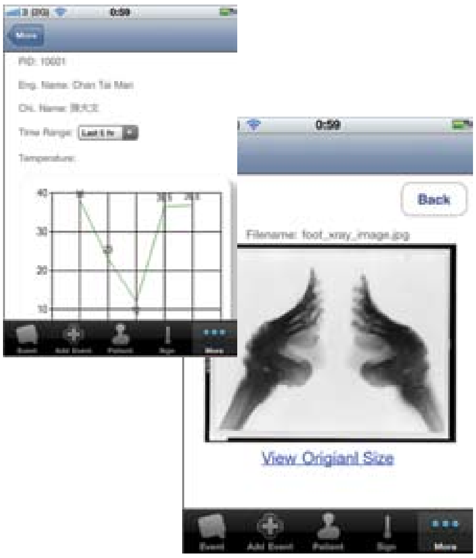
Various Designs of intravenous Infusion Monitoring System



Patient ID : 1001

Recording...

Voice Recording and clinical Photo taking Apps



PID: 10001

Eng. Name: Chan Tai Man

Time Range: Last 1 hr

Temperature:

Filename: foot_xray_image.jpg

View Origianl Size

Mobile Reader Apps

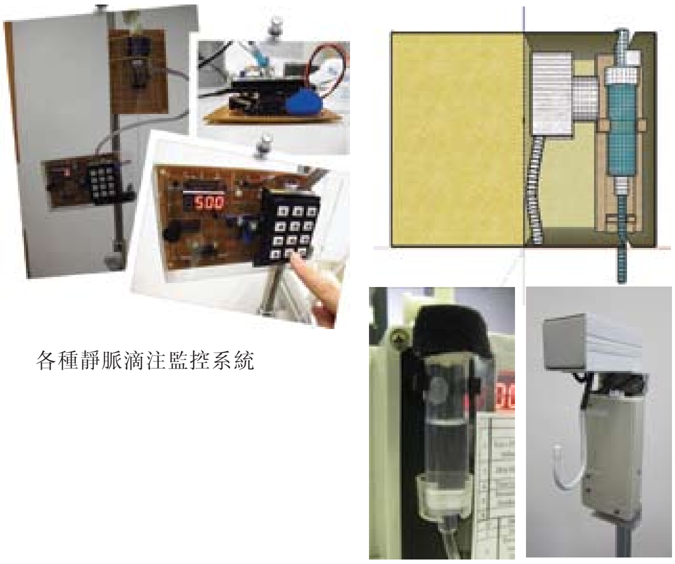
7. 展覽摘要

7.2 科訊廊展覽摘要
P2: 智能病房－流動及監測設備

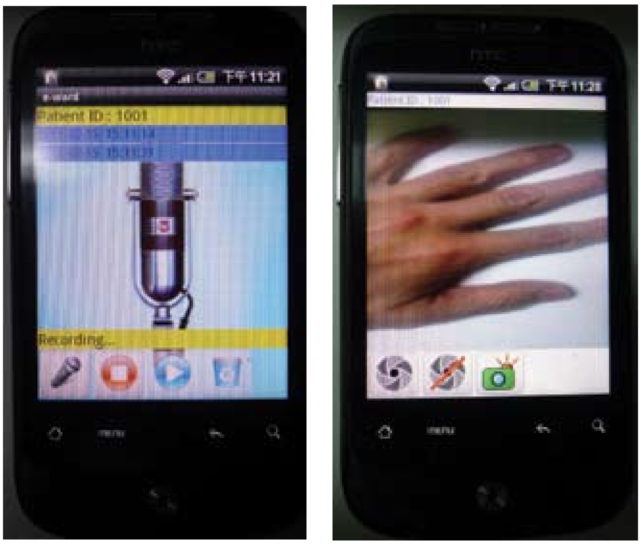
有八個生命體徵對於監測病人身體狀況很重要，包括溫度、脈搏、血壓、血氧飽和度、生物體液的輸入與輸出、排泄、血糖和中心靜脈壓（CVP）。

香港中文大學生物醫學工程系的學生，研發了多種可監測生物體徵的儀器。透過無線網絡，將採集得的數據，傳送到加密的中心系統和其他無線裝置。

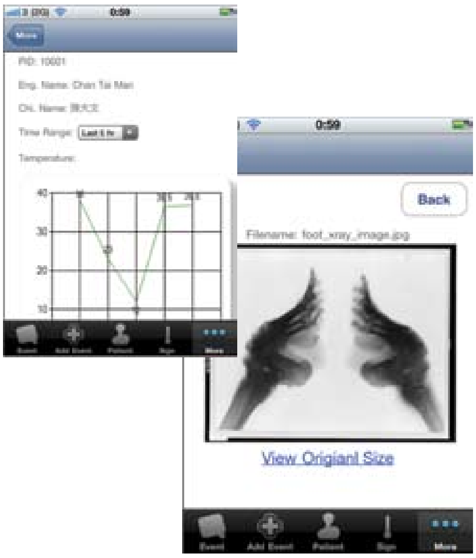
具有無線傳輸功能的血壓與心律測量器



各種靜脈滴注監控系統



具有錄音與照相功能的無線電設備的應用程式



PID: 10001

Eng. Name: Chan Tai Man

Chi. Name: 陳大文

Time Range: Last 1 hr

Temperature:

Filename: foot_xray_image.jpg

流動閱讀的應用程式

7. Abstracts of Exhibitions

7.2 Abstracts of Exhibition Panels at Science News Corner

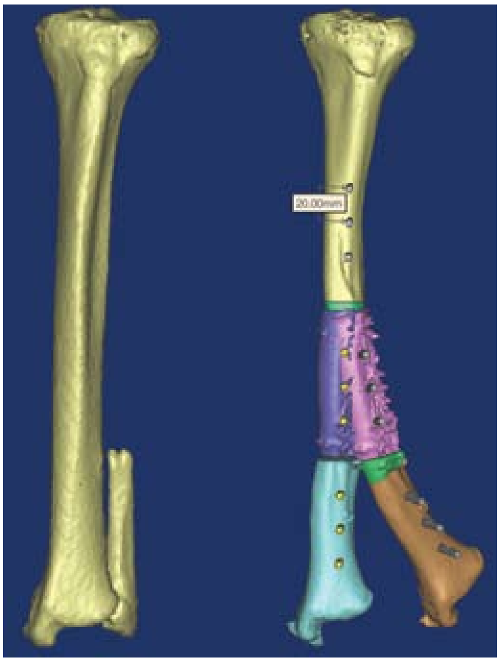
Panel 3: Computer Assisted Fracture Surgery

Resulting from congenital disease or fractures not healing in the ideal environment, some patients may have limbs that are severely deformed.

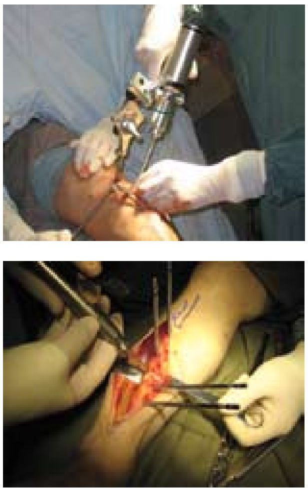
Here shows an example of a patient with multi-planar deformity of tibia. He needs two surgical cuts on his tibia in 3-dimensional space to achieve normal alignment. Computer program allows orthopaedic surgeons to perform this complex correction in the computer before committing the patient in the operating theater (preoperative planning).

The most ideal surgical cuts can thus be decided ahead of time. During the operation, the designed surgical cuts can then be exported to a surgical navigation system which guides the surgeon to make these surgical cuts exactly as planned in the computer.

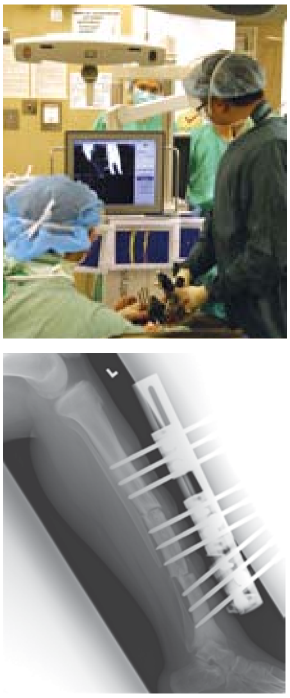
Before operation, this patient's deformity has resulted in his foot kicking backwards by 58 degrees, tilting outwards by 24 degrees and his foot rotating outwards by 30 degrees.



Computer program called MIMICS® converts the CT scan of the patient shin bones to objects that can be manipulated virtuallyby the surgeon. The surgical cut (osteotomy) also simulated. Cut planes and final bone positions can be marked by pins. The video above shows the computer preoperative planning in a similar patient.



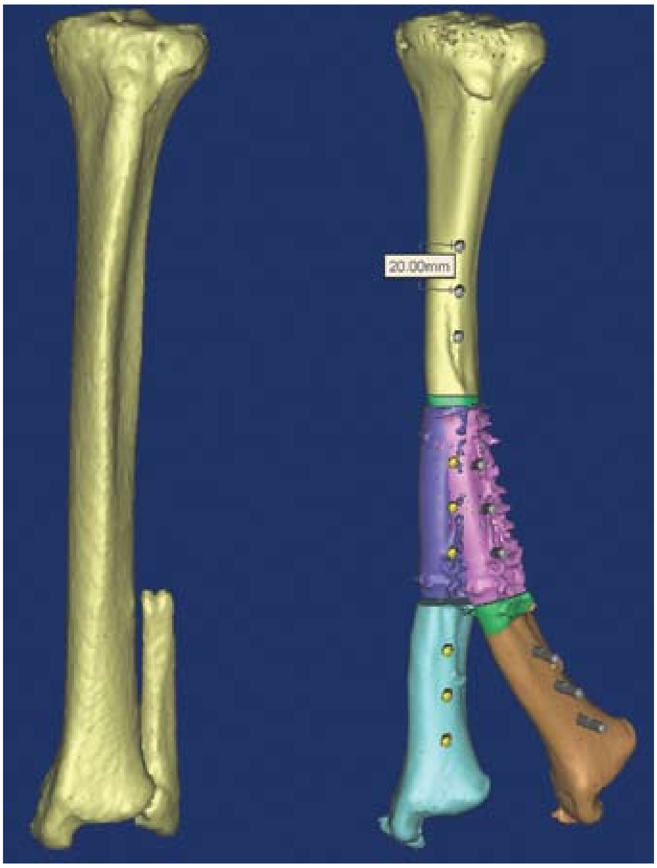
During the operation, real surgical pins can then be placed with navigation guidance. Bone cutting and bone positioning are guided by the pins.



7.2 科訊廊展覽摘要

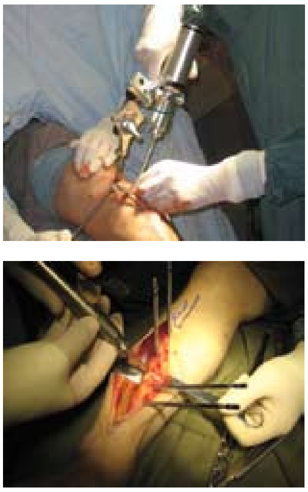
P3: 電腦輔助骨折手術

由於先天性疾病或骨折後未能接受適切的治療，會導致肢體嚴重畸形。這裡講述處理多角度脛骨畸形的手術過程。骨科醫生在三維空間下替患者進行兩次切割手術， 達到矯形效果。在規劃手術時，醫生透過特製的電腦程式，先在電腦中模擬整個複雜的流程，並設定理想的切口位置及角度。施行手術期間，手術導航系統能偵測矯正的位置，並按照預先設定的手術切割路線，協助骨科醫生進行更準確的切割手術。

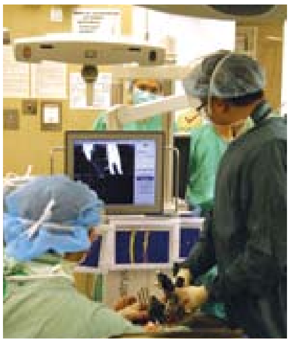


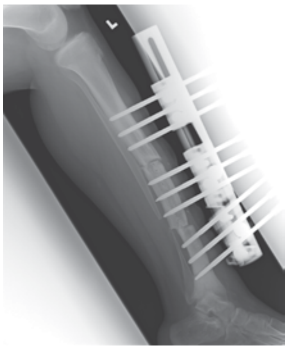
名為MIMICS®的電腦系統將脛骨的電腦斷層掃描影像，轉換為能讓骨科醫生自由操控的立體實物圖，並在電腦中模擬切割手術，再用導針對切割面及特定位置進行標記。

手術前，病人的畸形位置被確診為腳後彎58度，外彎24度，旋轉側彎30度。



手術中，導航系統引導狹長的導針進行定位及脛骨切割。





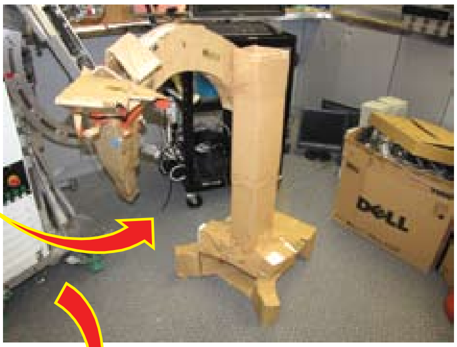
7. Abstracts of Exhibitions

7.2 Abstracts of Exhibition Panels at Science News Corner

Panel 4: Robot Assisted Orthopaedic Surgery

The newly designed semi-active surgical robot provides both manual and automatic controls for the surgeon to manipulate the robot arm to the target surgical position and executions. 7 degree of freedom with custom designed serial constructs enables smooth and effective robotic motions. This new surgical robot arm, combining with human dexterity, quick decision making and execution, stability and repeatability of the robot arm, greatly improves accuracy and precision of the existing CAOS systems, allows the orthopaedic surgeons to perform surgical procedure of high precision with predicable clinical outcome.

The 1st generation of surgical robot



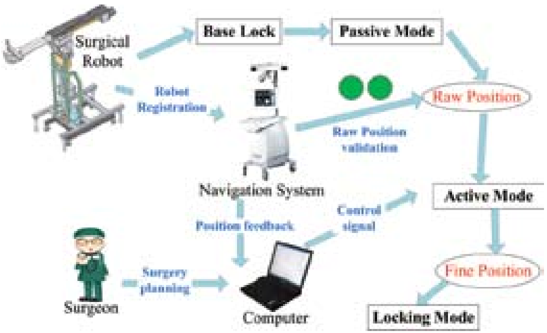
Paper prototype of the 2nd generation robot for early testing and modification

Engineering drawing of the 2nd generation robot for analysis and fabrication.

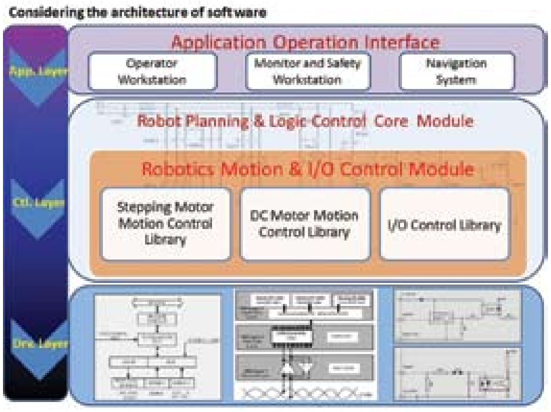
Accuracy testing in the factory after the fabrication is completed

Mechanical testing of robot during fabrication.

Application of the surgical robot during orthopaedic surgery



Working mechanism of the surgical robot



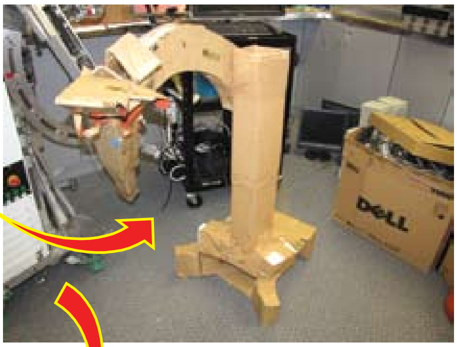
Software design workflow of the surgical robot

7.2 科訊廊展覽摘要

P4: 機械人輔助骨科手術

新設計的半自動手術機械人，讓外科醫生選擇手動或自動模式操控機械臂至目標位置及執行手術。具有7個自由度的特製設計使機械臂的動作有效流暢。這個手術機械臂可集人腦的靈活性和快速的決策執行能力、及機械臂的穩定性與可重複性等多種優點於一身。大大地提高了現有的CAOS系統的準確度與精確度，讓骨科醫生能很精確地施行手術，得到預期的臨床效果。

第一代手術機械臂



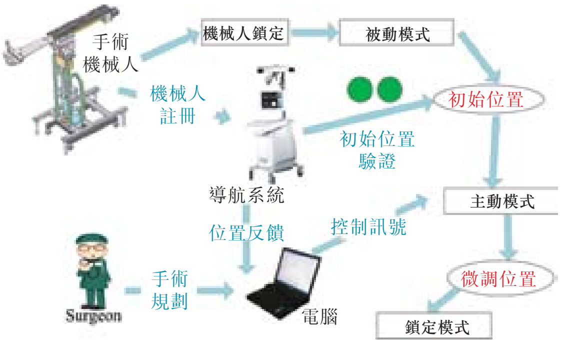
第二代手術機械臂的紙板模型，以便初期測試及改進

第二代手術機械臂的工程圖， 以便分析及製造

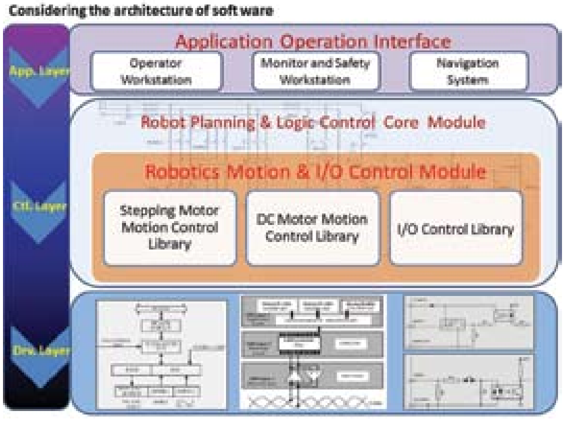
製成品進行誤差測試

機械性能測試

手術機械臂應用於手術用途



手術機械臂的運作機制



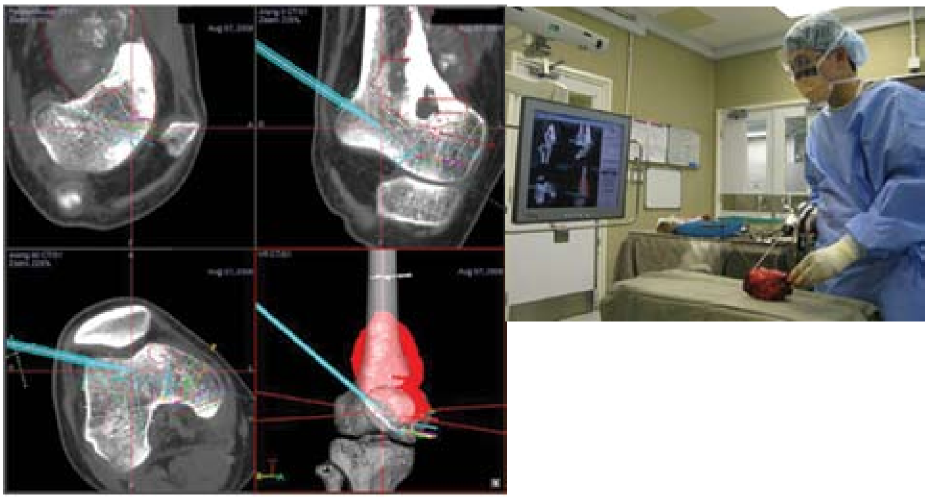
利用軟件程式編制手術機械臂的操作流程

7. Abstracts of Exhibitions

7.2 Abstracts of Exhibition Panels at Science News Corner

Panel 5: Computer Assisted Tumor Surgery

Surgical management of paediatric bone sarcoma is challenging. Effective chemotherapy and advances in surgical techniques make limb sparing surgery possible and offers adequate disease control comparable to the results obtained by amputations. With advances in design, material technology and surgical techniques, modern implanted tumor prostheses are more durable, less short term complications and can achieve good limbs function.



After navigation assisted tumor resection, resection margin can be achieved precisely and validated during surgery.
以導航輔助技術切除腫瘤，醫生可準確切除有害的組織。

Computer assisted tumor resection surgery set up in surgical theatre – enhance surgical precision and accuracy
進行電腦輔助腫瘤切除手術的過程。

7.2 科訊廊展覽摘要

P5: 電腦輔助腫瘤手術

兒童骨科腫瘤的手術治療甚具有挑戰性。相對於截肢，有效的化療和先進的手術技術， 既能避免切除整段肢體，又可控制病情。

而假體的設計、材料科技及手術技術的進步，使現今植入的假體更耐用，手術後出現短期併發症的機會更低，亦能提供更佳的功能。

Expandable implant allow the best functional outcome especially in paediatric patients, allowing limb length correction upon maturity after long term survival from disease
可擴展性人工假體對兒童患者尤其有幫助，它可因應兒童成長作相應調校。

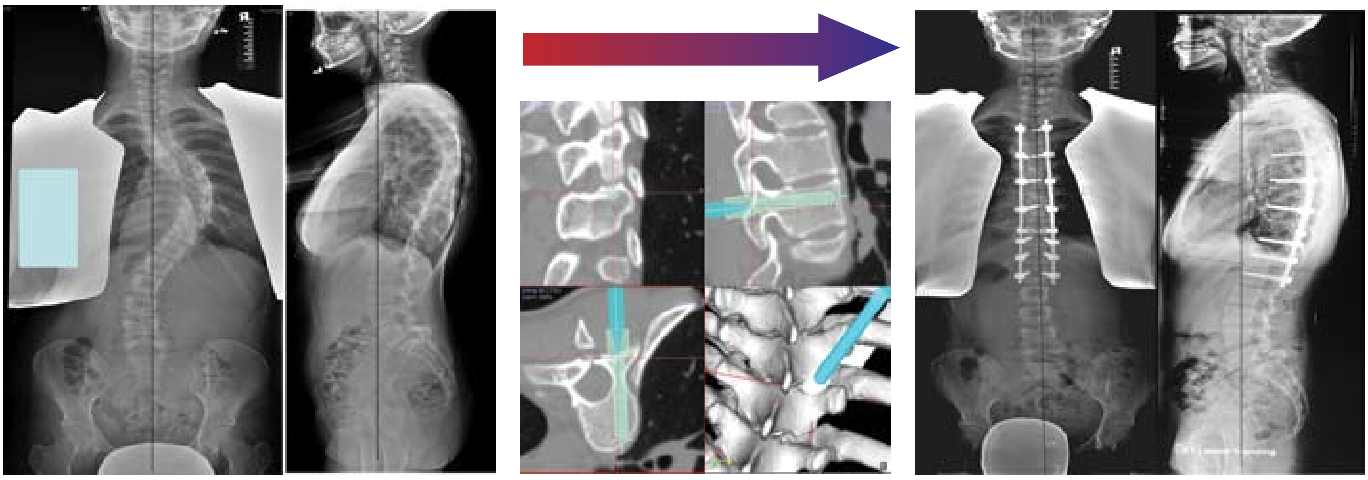
Case of femur osteosarcoma. CATS technology helps to improve surgical margin and for precise prosthesis fitting
股骨骨瘤的病例電腦輔助腫瘤手術有助改善手術切口的完整度，及準確植入假體。

7. Abstracts of Exhibitions

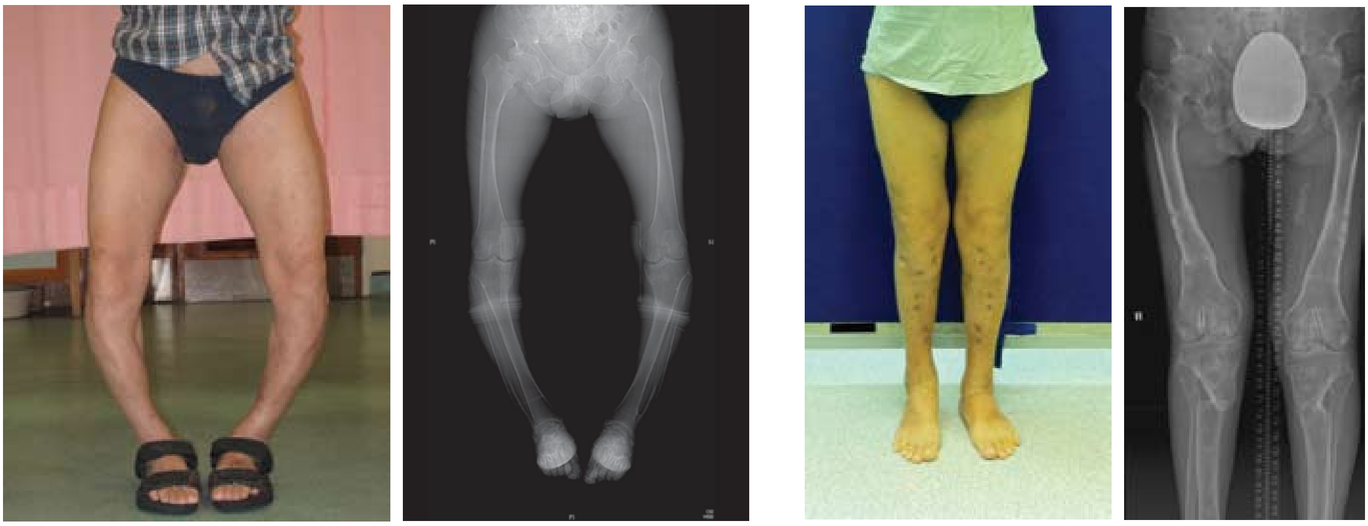
7.2 Abstracts of Exhibition Panels at Science News Corner

Panel 6: Computer Assisted Complex Limb and Spinal Deformity Surgery

Limb and spinal deformity caused major functional and cosmetic morbidity to patients. Advancement in technology had significantly improved the predictability, precision, patient comfort and safety margin of these major corrective surgeries, with much less complications involved.



Precise placement of pedicle screws to avoid injury to vital organs
Allow maximal bone fixation for optimal correction
精準的螺絲落點能大大避免損害重要器官
更全面地固定矯形後的肢體



Restoration of normal lower limb alignment
下肢矯正前後對照圖

7.2 科訊廊展覽摘要
P6: 電腦輔助肢體及脊柱畸形矯正手術

畸形的肢體及脊柱影響活動功能及外觀的健全。先進的技術發展有效改善了矯形手術中常見的問題。骨科醫生可預測手術的效果、調較手術儀器的角度以提高精確性、病人比以往承受較少的創傷，同時，降低了併發症的風險。因此，矯形手術可在更安全的情況下進行。

3D-CT based preoperative surgical planning
利用三維空間定位導航作手術前的規劃

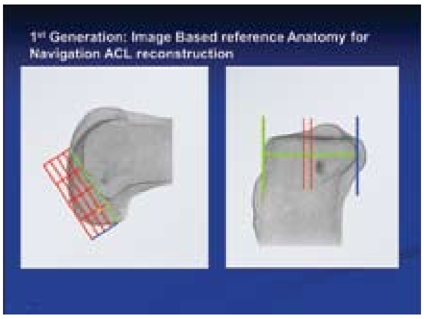
Real time navigation guided placement of bone fixation pins followed by percutaneous mini-invasive osteotomy
利用實時立體影像, 經皮膚導入狹長的導針, 並進行微創截骨手術

Realignment of limb on external fixator
運用體外固定支架,重新固定肢體的位置

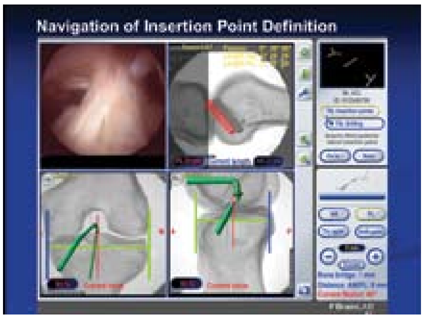
7. Abstracts of Exhibitions

7.2 Abstracts of Exhibition Panels at Science News Corner

Panel 7: Navigation Assisted Sports Surgery


1st Generation: Image Based reference Anatomy for Navigation ACL reconstruction

1st Generation: Image Based reference Anatomy for Navigation ACL reconstruction


Navigation of Insertion Point Definition

Navigation of Insertion Point Definition

Anterior Cruciate Ligament (ACL) is one of the most commonly encountered sports injuries in Orthopaedic practice. Currently, quite a lot of surgeons perform anatomical double bundle ACL reconstruction, so as to improve the rotational stability and thus the final clinical functional outcome of ACL reconstruction of the knee. In recent years, there are more and more papers reporting the clinical results and outcome of Double Bundle ACL reconstructions, including reported complications and problems encountered during double bundle ACL reconstructions, like posterior blow out, anterior impingement & bridging of tunnels in femur or tibial side. The application of computer navigation technique has the benefits of allowing precise planning of the tunnel position before drilling in performing double bundle ACL reconstructions, so as to prevent all those complications as mentioned. Moreover, computer navigation is also a very useful assessment tools to measure the kinematics of the knee during the operation, which is important for surgeons to understand the kinematics of knee, particularly for Double Bundle ACL reconstruction, and for researches and documentations of results. There are also other potential development and application of Navigation in ligament reconstruction of the knee which are still in the stages of researches and application in clinical practice.


Preparation for surgical operation


General set up for Navigation assisted Knee ligament reconstruction


Fluoro-based and image free workflows

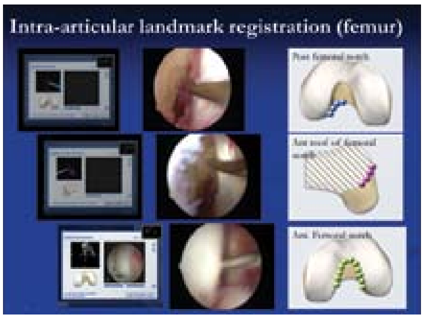

Ready for pre-operation stability test and pivot shift test


Registration of anatomical landmarks of the knee


Intraarticular landmark registration (Tibia)

- PCL ant. edge
- Med. tibial spine
- Lat. meniscus

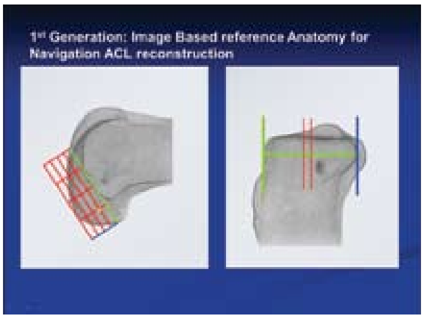
Intraarticular landmark registration (Tibia)


Intra-articular landmark registration (femur)

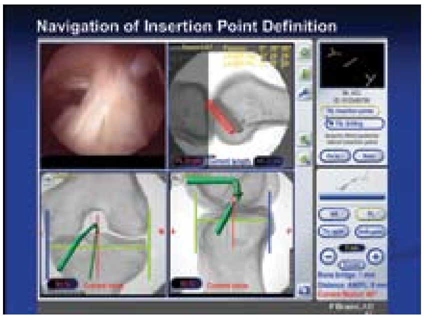
Intraarticular landmark registration (femur)

7.2 科訊廊展覽摘要

P7: 導航輔助運動創傷手術


1st Generation: Image Based reference Anatomy for Navigation ACL reconstruction

第一代以影像為基礎的前十字韌帶重建導航手術


Navigation of Insertion Point Definition

以導航技術指示手術切入點

前十字韌帶損傷是骨科中最常見的運動創傷。現在，很多外科醫生施行解剖的前十字韌帶二束重建手術，從而提高了轉動的穩定性，及得到更好的臨床效果。近年來，越來越多醫學文獻對雙束雙隧道前十字韌帶重建手術的臨床效果進行研究，當中包括手術的併發症及重建中遇到的問題，例如，後股骨的撞擊、前膝關節碰撞，以及股骨或脛骨骨內隧道的連接。電腦導航技術的應用，讓醫生進行鑽骨前，能精確定出隧道的位置，從而避免了以上的問題。此外，電腦導航技術有助於手術中測量膝關節運動學數據，特別對於雙束雙隧道前十字韌帶重建手術來説，讓醫生了解膝關節的運動學數據是很重要的，另外這些數據也可用於研究及記錄手術成效的用途。在膝韌帶的重建手術中，導航系統還有其他潛在的發展及應用，但現時仍處於臨床實踐的研究階段。


手術前預備


膝蓋韌帶重建導航手術設置


以透視技術為基礎，無需依賴圖像

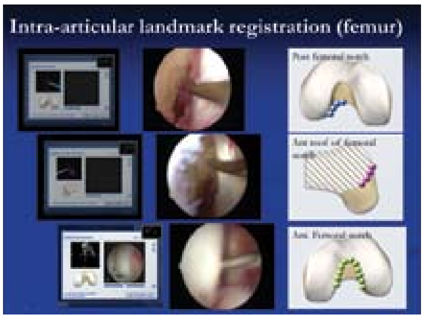

準備手術前穩定測試及軸移測試


將病人膝蓋解剖位置輸入導航系統


Intraarticular landmark registration (Tibia)

- PCL ant. edge
- Med. tibial spine
- Lat. meniscus

脛骨關節活動角度定位


Intra-articular landmark registration (femur)

股骨關節活動角度定位

7. Abstracts of Exhibitions

7.2 Abstracts of Exhibition Panels at Science News Corner
Panel 8: Navigation Assisted Joint Replacement Surgery

Total joint replacement surgery had great success in the last 50 years. Several factors had been identified as the prognostic factor of its success, young age and malalignment. Young patients had higher risk of failure because of the demand on the artificial joint. If the artificial joint was being put in a malaligned position, the risk of failure was tremendously high. Computer navigation was developed to address the malalignment problem. It had been adopted in total joint replacement surgery in the late 1990's. It can be a CT based or CT free option.

Imageless computer navigation in total joint replacement surgery does not require a CT scan or MRI scan before the operation. All the data are obtained in the operating room by registering with the computer using infrared reflection. Trackers have to be firmly attached to the patient and the surgeon has to register certain landmarks of the patient as required by the computer. After the registration process, the computer will generate a model using the input data. The computer can help the surgeon to choose the size of the artificial joint, ligament balancing, measure the range of motion and alignment of the diseased joint. After the surgeon has confirmed that all the data are correct, the computer will guide the surgeon in determining the position and alignment of the cutting jig. After completing all steps, the computer can help the surgeon to countercheck the motion and alignment of the joint.

In Hong Kong, the first CT free (imageless) computer navigation in total joint replacement surgery was performed in 2001. In the last 10 years, more than 500 computer assisted total joint replacement surgery had been performed in Hong Kong. The proven results had been widely studied and published in different peer review journals.

Fig 1 Pre-operation alignment

Fig 2 Pre-operation ROM (Range of Motion)

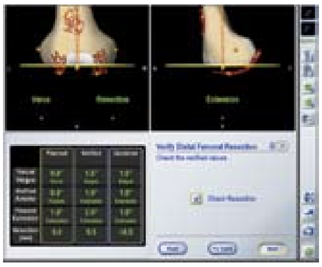


Fig 3 Distal femur resection

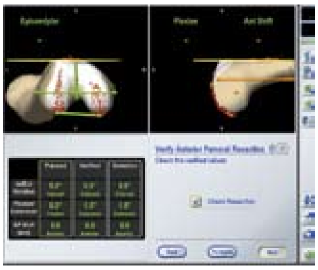


Fig 4 Femoral resection

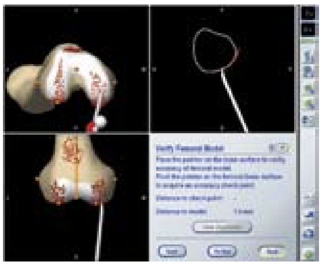


Fig 5 Femoral model verification

Fig 6 Tibia resection

Fig 7 Tibia model verification

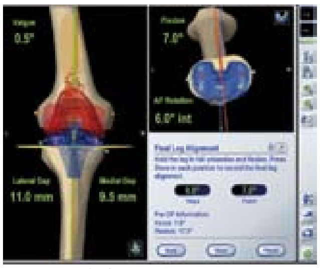


Fig 8 Final alignment

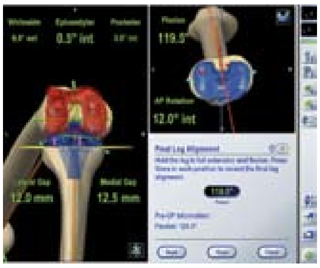


Fig 9 Final and ROM (Range of Motion)

7.2 科訊廊展覽摘要
P8: 導航輔助關節置換手術

在過去的五十年，全關節置換術取得了巨大的成功。病人的年齡以及準確的植入位置，是影響關節置換成功與否的關鍵因素。年輕病人一般更倚重人工關節，因此失敗風險亦相應提高。如果人工關節的植入位置稍有偏差，則手術失敗的風險將極高。於九十年代後期，電腦導航被應用到全關節置換手術當中，幫助解決誤差的問題。醫生可選擇單獨或結合電腦斷層掃描技術進行手術。

全關節置換術中的無影像電腦導航，不需要在手術前進行電腦斷層掃描或磁力共振掃描。所有數據皆在手術室由電腦配合紅外線反射器定位而獲得。病人身上需穩固上追蹤器，醫生須按照電腦軟件程式，對病人身上的特定標記進行定位確認。確認標記後，電腦會利用輸入的數據建立一個立體模型。電腦能協助醫生選擇人工關節的尺寸、韌帶的平衡度，測量關節的活動範圍，以及病變關節的錯位。之後，醫生會逐一確認所有的數據正確無誤，電腦將引導醫生決定手術切削夾具的位置及角度。電腦亦可幫助醫生覆查人工關節的運動及對位。

香港首個無影像電腦導航的全關節置換手術在2001年施行。在過去的10年裏，本地進行了超過五百個電腦輔助的全關節置換手術，顯著的手術成效更被廣泛討論並刊登在著明的科研刊物上。


圖 1 手術前調整股骨及脛骨位置


圖 2 手術前測量關節活動範圍

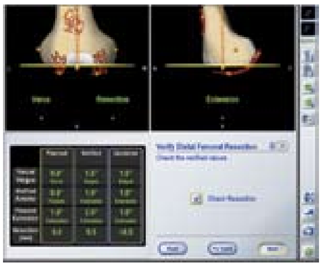


圖 3 調整遠端股骨切割位置

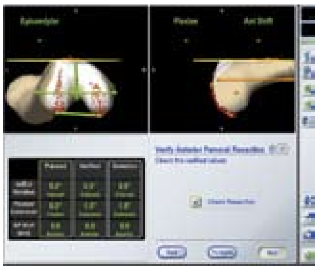


圖 4 調整近端股骨切割位置

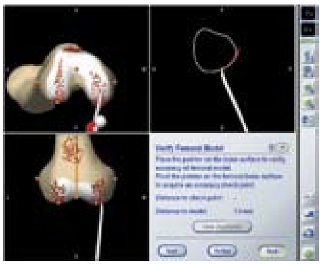


圖 5 確認股骨切割位置

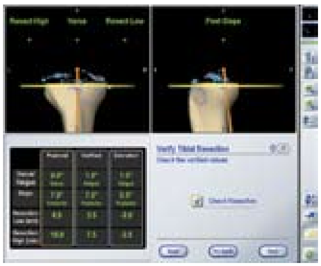


圖 6 調整脛骨切割位置


圖 7 確認脛骨切割位置


圖 8 確認最終位置

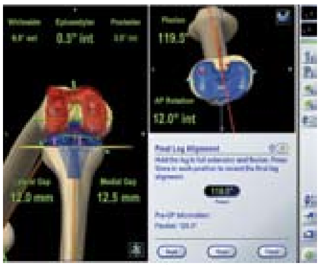


圖 9 確認最終關節活動範圍

7. Abstracts of Exhibitions

7.2 Abstracts of Exhibition Panels at Science News Corner

Panel 9: Robot Assisted Urology Surgery

Robot-assisted surgery was first performed in 1988. In the past 20 years there is an ever increasing application of this technology. The first machine in Hong Kong was installed in CUHK Jockey Club Minimally Invasive Surgical Skills Centre in 2005, sponsored by the Hong Kong Jockey Club and Kai Cheong Tong Foundation. Prince of Wales Hospital performed the first robotic-assisted surgery in the same year in a patient whom received partial nephrectomy treatment.

This machine was named "daVinci", a famous Italian Renaissance artist and polymath as a sketch of a "robot-like" machine was found in his 1495 manuscript. mainly as an attribute to Leonardo di ser Piero da Vinci, an Italian Renaissance polymath. Leonardo was not only a famous artist, sculptor and musician; he was also revered for his technological ingenuity with sketches of a "robot-like" machine found. Although his design could not be put into practical use at his times, but they provided innovative ideas for future development.

The advantages of the machines are their patented "Endowrist" with six-degree of movement, allowing greater flexibility of fine movement and three dimensional magnified view of dual channel endoscopy. Surgery can therefore be performed in a more precise way and there are also ergonomic advantages for surgeons. These features are so important that patients' surgical outcomes are improved. In general, there is less blood loss, and hence less need for transfusion and lowering the risk of potential complications caused. Most importantly, the recovery period of patients also hastens with less complications.

Taking prostatectomy as an example, rates of urinary incontinence and sexual dysfunction can be reduced. The prognosis after tumor surgery can also be improved as a result of clearer resection margin with precision. This technology has been widely applied in urological surgeries, including prostatectomy, bladder resection, pyeloplasty, partial nephrectomy and ureter surgery, etc. Prince of Wales Hospital operates about sixty robotic assisted cases every year and the overall surgical outcome is satisfactory. The application of this technology is also expanding to gynecological surgery, general surgery, etc.

Robot for urology surgery

Setup of robot assisted surgery system in operation room

7.2 科訊廊展覽摘要

P9: 機械人輔助泌尿外科手術

隨著首次機械人輔助的外科手術於1988年施行，二十多年來，這項技術得到了進一步的改良和應用。香港第一套達文西機械人輔助手術系統由香港賽馬會及繼昌堂基金捐款贊助，安裝在位於威爾斯親王醫院的香港中文大學賽馬會微創醫療技術培訓中心 (MISSC) 。

該手術系統以學識淵博的意大利著名藝術家達文西命名，是因為達文西在1495年的手稿中夾著一張被認為是第一份人形機械人的設計圖。威爾斯親王醫院於2005年利用此手術系統進行了機械人輔助腎切除手術。

達文西系統的優點在於其專利的模擬手腕設計，提供六個方向的移動，使機械臂的動作更靈活精確， 同時提供雙鏡頭三維景深和高解象的視像 。因此，手術能做得更精準，對醫生操作來說亦更符合人體工程學，這使手術效果也大大提升了。

相對於開放式手術，這微創手術減少了失血，因而減少了輸血的需要及其風險，更重要的是它加快了手術後的康復及降低了併發症的發生。

以前列腺切除術為例，它可減低小便失禁及勃起功能障礙的風險。腫瘤切除手術後的康復機會亦由於它能更精確的切除所有癌細胞而得以提高。

此項技術已被廣泛應用於泌尿外科手術，如前列腺切除、膀胱切除，腎盂重建，腎組織切除，以及輸尿管手術。

威爾斯親王醫院每年平均利用達文西機械人輔助手術系統進行約六十個外科手術，而且手術效果令人滿意。這項技術也逐步應用到婦科及普通外科手術。

泌尿外科手術機械人

設置機械人輔助手術系統

7. Abstracts of Exhibitions

7.2 Abstracts of Exhibition Panels at Science News Corner

Panel 10: Navigation Assisted Neurosurgery: Brain Tumor Surgery

In 1986, Roberts et al. reported the development of a frameless, computer-based system for the integration and display of CT image data with the operating microscope. A frameless, armless, navigational system was based on a three-dimensional digitizer to determine the spatial position of the instruments. The adapters are simply screwed onto surgical instruments. In this way, many surgical procedures can be performed with this navigation system.

We use the neuronavigation system in our department for operations including brain tumor surgery and endoscopic procedures. The time required for data transfer, delineation of the lesion, and reconstruction is approximately 10 minutes. The marker registration can be performed in a sterile or non-sterile fashion. Another advantage of the neuronavigation system lies in the combination with the operating microscope. After the marker frame is mounted, all microscopes equipped with a serial computer interface can be used as a pointer with the navigation system. The navigation system is very useful for planning the surgical approach.

The skin incisions and craniotomies are smaller than without the system. Using virtual planning of the trajectory, we never performed an exploration with negative results. The system is also very useful for surgical treatment of cranial base lesions. Even for large cranial base lesions (for example, olfactory groove meningiomas), the navigation system proved to be helpful for determination of the position within the tumor and for calculation of the distances to important structures. In our experience, neuronavigation brings us forward in the concept of minimal access neurosurgery and has shortened the hospital stay of our patients.

Min. Instrument Length: 211 mm

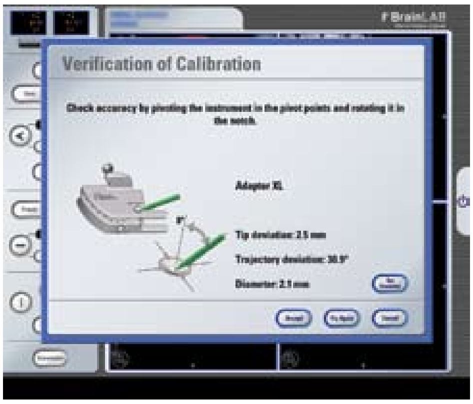
Lock joint!

Adjust the VarioGuide over the entry point.

Coarse adjustment of surgical position

Verify the correct alignment.
Estimated target deviation: 0.2 mm

Virtual adjustment of surgical position completed



Check accuracy by pivoting the instrument in the pivot points and rotating it in the notch.

Adapter XL

Tip deviation: 2.5 mm

Trajectory deviation: 30.9°

Diameter: 2.1 mm

Verification of calibration

Neuronavigation system integrates and displays CT and MRI image data

7. 展覽摘要

7.2 科訊廊展覽摘要
P10: 導航輔助腦外科手術：腦腫瘤手術

在1986年，羅伯特等人向公眾展示了一個無框架(立體定向框架，固定在病人頭骨上)、以電腦為基礎，可顯示及融合了電腦斷層掃描與手術顯微鏡的系統。這無框架、無機械臂的導航系統是基於三維數字化儀測出儀器的位置。轉接器只須簡單的扭緊在手術儀器上。這使此導航系統可應用於許多外科手術。

除了腦腫瘤和內窺鏡手術，威爾斯親王醫院亦將神經導航系統應用於其他腦外科手術。數據傳輸、病變位置的描繪以及圖像重組需時約十分鐘。確認標記的步驟可於消毒或無消毒的情況下進行。神經導航系統的另一個優點是與手術顯微鏡結合使用，當固定各個標記後，所有裝配有相關電腦導航界面的顯微鏡都可用作導航的指示點。導航在手術規劃方面十分有用。

使用此系統時皮膚切口和顱骨切口會比較小。使用虛擬技術作手術規劃，威爾斯親王醫院從未出現負面的效果。導航系統對於顱底病變的外科手術也非常有用。即使是大面積的顱底病變，例如嗅覺神經溝腦膜瘤，導航系統仍能計算出儀器在腫瘤中的位置及其與重要器官的距離。從經驗得知，神經導航為我們引入了微創神經外科的概念，並且縮短了患者住院的時間。

Coarse Adjustment

Min. Instrument Length: 211 mm

Lock joint!

Adjust the VarioGuide over the entry point.

初步調整手術位置

Adjustment Completed

Joint 1: -0.1 °

Joint 2: 0.1 mm

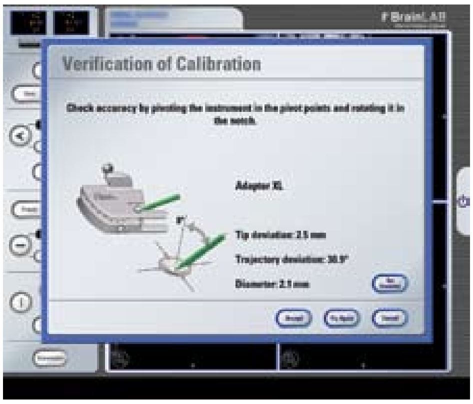
-0.1 °

Joint 3: -0.1 °

Verify the correct alignment.

Estimated target deviation: 0.2 mm

完成虛擬手術定位



Verification of Calibration

Check accuracy by pivoting the instrument in the pivot points and rotating it in the notch.

Adapter XL

Tip deviation: 2.5 mm

Trajectory deviation: 30.9°

Diameter: 2.1 mm

核實校準

導航系統整合及顯示電腦斷層掃描與磁力共振造像的數據

7. Abstracts of Exhibitions

7.2 Abstracts of Exhibition Panels at Science News Corner

Panel 11: Eagle Claw and Capsule Endoscopy

The current methods of endoscopic therapy are limited by the size of the bleeding vessel that hemostasis can be achieved. If the diameter of bleeding vessel is larger than 2mm, surgical plication with sutures achieved the best hemostasis. The concept of endoscopic suturing device , named Eagle Claw, was first proposed by Professor Sydney Chung. After several modifications, Eagle Claw VII was found to be very effective in achieving hemostasis for massively bleeding gastric ulcer.

With the concept of natural orifices transluminal endoscopic surgery, endoscopic suturing device became very important for closure of GI luminal access. After several studies, Eagle Claw was found to be safe and effective in closing the gastric openings. Eagle Claw is now modified into another device named Apollo Overstitch, and a clinical trial will soon be conducted to test the efficacy of overstitch in achieving hemostasis for bleeding peptic ulcers.

Figure 1 – Eagle Claw VII

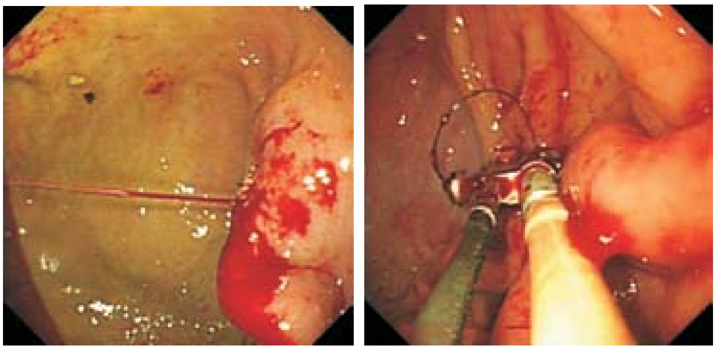


Figure 2 – Plication of massively bleeding ulcer with Eagle Claw

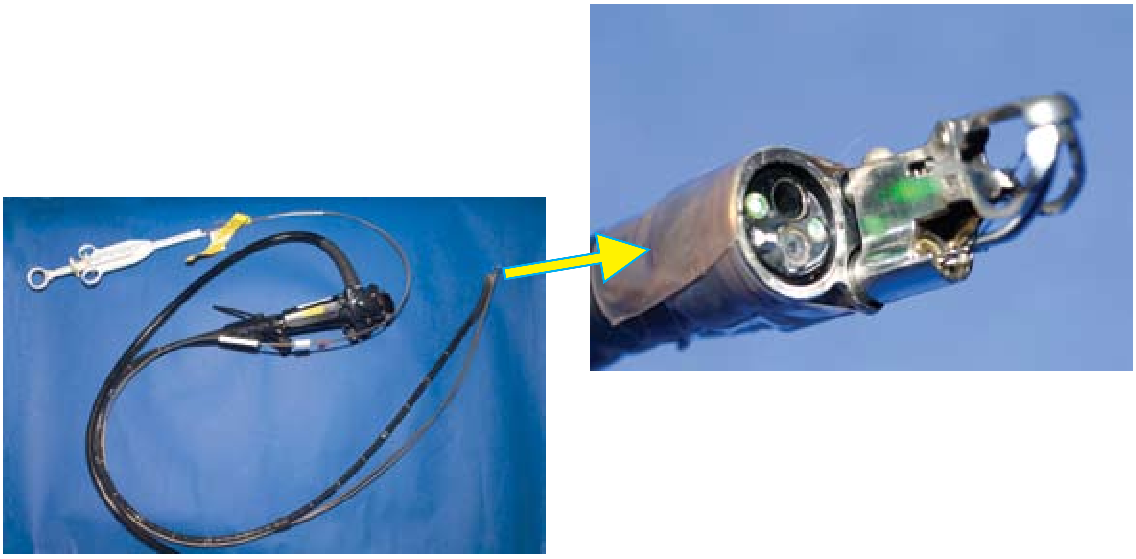


Figure 3 – Eagle Claw VIII

In 2000, the concept of capsule endoscopy was proposed by Paul Swain to identify the bleeding source in Gastrointestinal tract . The capsule endoscope consisted of a small camera, LED light source, batteries and data transmission through radiofrequency. The design appeared like a drug capsule to facilitate the passage of this small device through the small intestine. It can send out its location and images captured for analysis.

The results of clinical studies confirmed that capsule endoscope achieved a significantly better rate of completely examination of the whole small bowel, and identified the bleeding source positively. The development of capsule endoscope enabled gastroenterologists and surgeons for the first time to inspect and locate pathologies of the small bowel, which greatly enhanced the planning of subsequent management for these lesions. Active researches had been advocated towards the control of the capsule endoscope inside the gastrointestinal tract, as well as achievement of therapies through the capsule endoscope.

Figure 4 – Capsule endoscope

Figure 5 – Signal receiving units for capsule endoscope

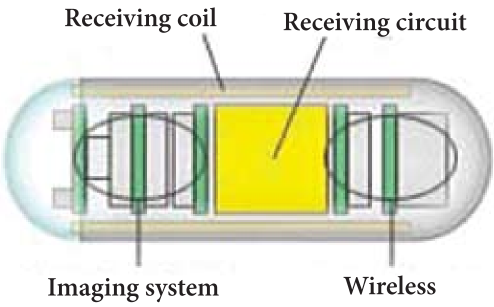


Figure 6 – the design of the capsule endoscope

7. 展覽摘要

7.2 科訊廊展覽摘要

P11: 內鏡縫合裝置“鷹爪”及膠囊內鏡

目前的內鏡治療受限於我們能對其進行有效止血的血管大小。如果血管的直徑大於兩毫米，手術縫合能達到最好的止血效果。鍾尚志教授首先提出內鏡縫合裝置的概念，其雛形被命名為鷹爪。經過多次改良，證實第七代鷹爪對於有大量出血的胃潰瘍具有很好的止血效果。

隨著經自然腔道內鏡手術的迅速發展，內鏡縫合裝置在閉合此手術造成之腸胃道孔道發揮著重要的角色。數個研究證明了鷹爪可安全有效地閉合胃壁的孔道。鷹爪現在被改良為另一名為Apollo Overstitch 的產品，並將就出血消化性潰瘍的止血效用進行臨床測試。

圖 1 — 第七代鷹爪

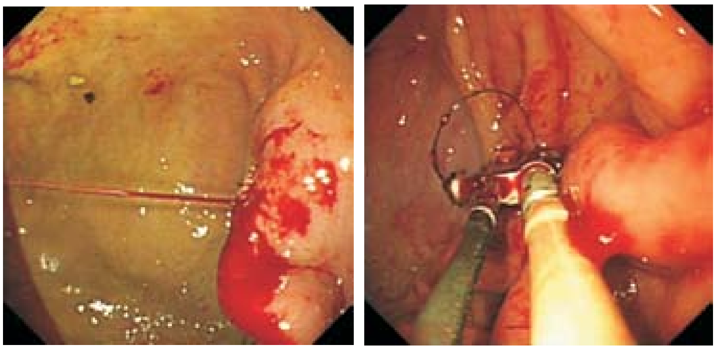


圖 2 — 鷹爪對大量出血性潰瘍進行縫合

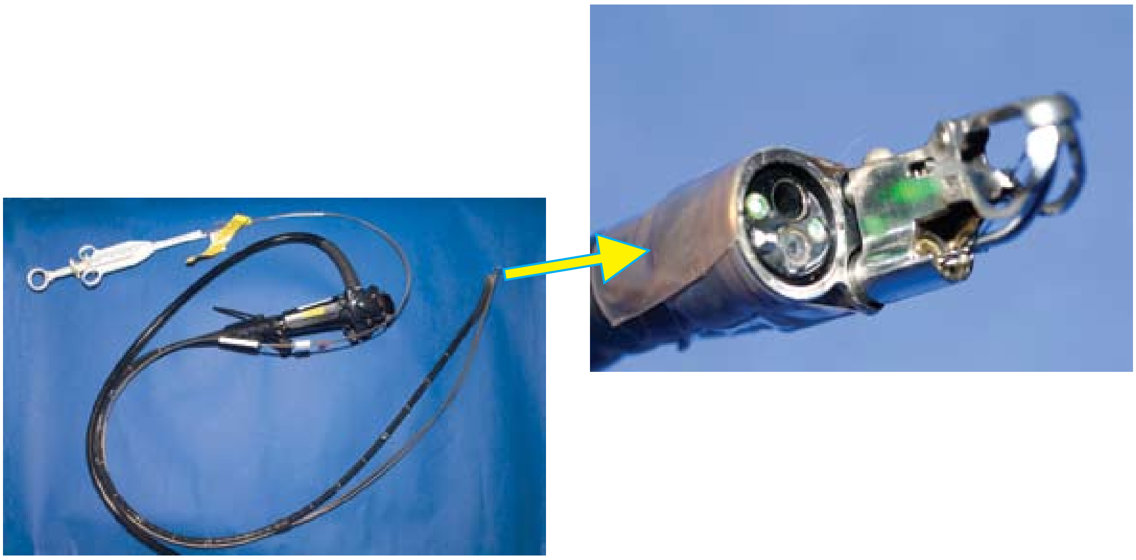


圖 3 — 第八代鷹爪

在2000年，Paul Swain提出了以膠囊內鏡的概念去偵測消化道內出血部位。膠囊內鏡包括一個微型相機、LED光源、電池和射頻數據傳輸裝置。其形狀類似藥物膠囊，使它較容易穿過小腸。膠囊可傳送出其位置及拍攝到的圖像以供分析。

臨床研究的結果證實膠囊內鏡能更徹底地檢查整段小腸及識別出血的源頭。膠囊內鏡的發展，使腸胃科專家及外科醫生能首次檢視小腸，找出病變的位置，讓醫生能盡快制定控制病灶的計劃。近年來，很多研究致力於操控膠囊視鏡於胃腸道的移動，以及利用膠囊內鏡作治療用途。

圖 4 — 膠囊狀內鏡

圖 5 — 膠囊內鏡的訊號接收裝置

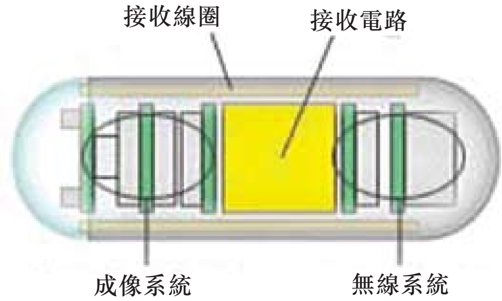


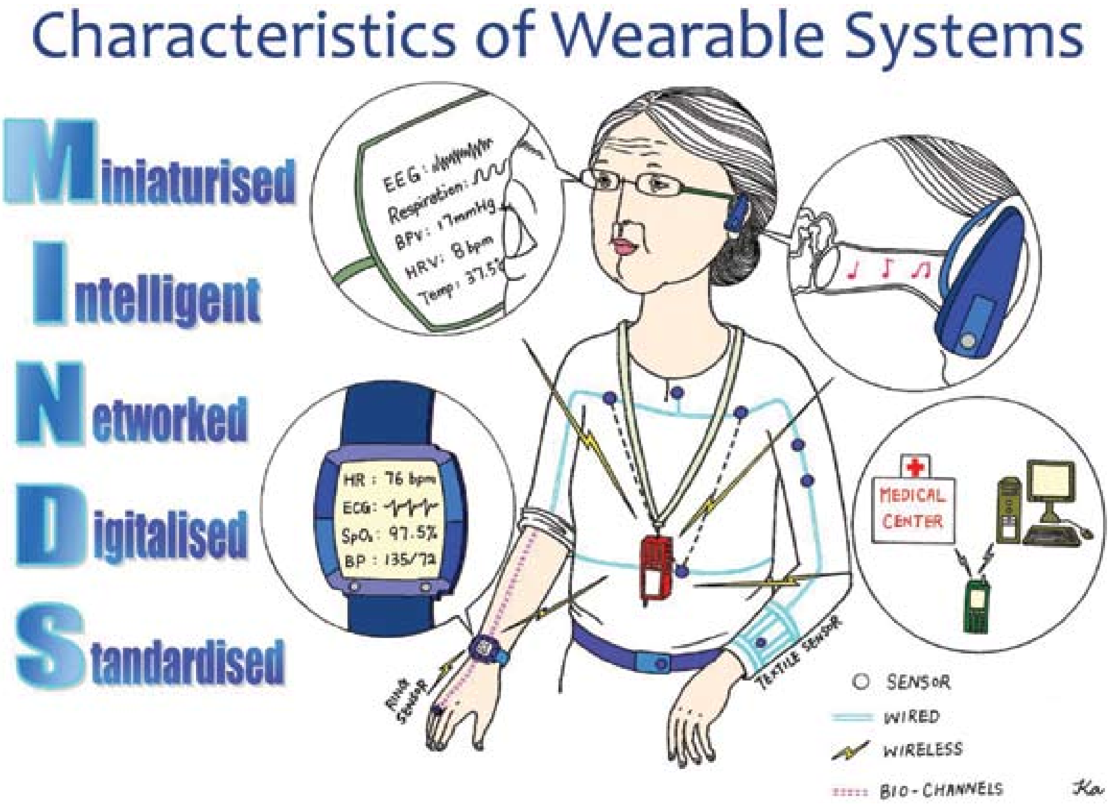
圖 6 — 膠囊內鏡的設計

7. Abstracts of Exhibitions

7.2 Abstracts of Exhibition Panels at Science News Corner
Panel 12: Smart Home - Wearable MINDS Technologies

Driven by the increasingly aging population, prevalence of chronic diseases, skyrocketing health costs and higher healthcare expectations, there is a pressing need to shift the conventional hospital-centred medical model towards a p-Health paradigm.

The p-Health paradigm relies partly on new acquisition systems that can capture health information of an individual at home during daily lives, providing early notify to the individual and relevant clinical personnel before a disease or severe health problems have developed. One example of new acquisition systems for early detection of diseases is the wearable systems, of which enabling technologies entail characteristics of ***MINDS: miniaturised, intelligent, networked, digitalised*** and ***standardised***.



Enabling technologies of the wearable systems entail characteristics of MINDS: miniaturised, intelligent, networked, digitalised and standardised.

7.2 科訊廊展覽摘要
P12: 智能家居—穿戴式MINDS技術

隨著人口老年化的加劇、罹患慢性疾病的人數增多、醫療費用的增加，以及人們對醫療保健的更高期望，我們有需要加快將傳統以醫院為中心的醫療模式轉向一個“p-健康”模式。“p-健康” 模式需要新的健康信息提取系統，已到達早預防、早診斷、早治療的目的。其中，穿戴式系統有助於人們在家庭並日常生活中檢測健康信息。建立此系統需具備以下的技術：小型化、智能化、網絡化、數字化和標準化。

穿戴式系統的特點

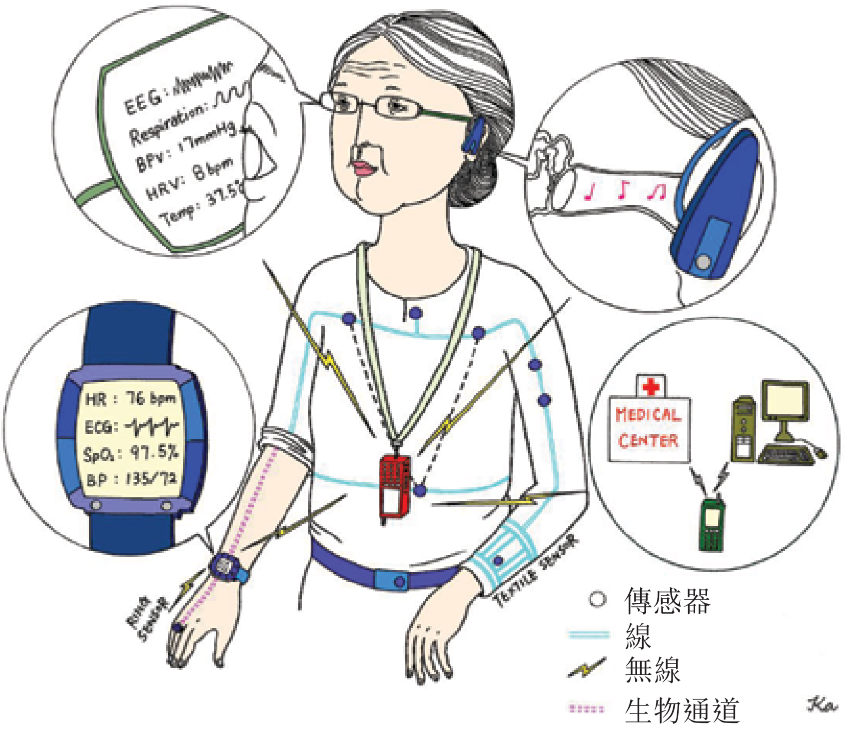
小型化

智能化

網絡化

數字化

標準化



在技術上，要求這種穿戴式系統具備以下特點：小型化、智能化、網絡化、數字化，以及標準化。

7. Abstracts of Exhibitions

7.2 Abstracts of Exhibition Panels at Science News Corner
Panel 13: Breath Diagnosis

Breath is composed of a mixture of gases, water vapor and characterized distinctively by >1000 trace volatile organic compounds and protein molecules. These endogenously generated breath biomarkers provide a window into the metabolic state of the body. For instance, exhaled nitric oxide is a biomarker to indicate the severity of respiratory inflammation and exhaled acetone is used to monitor diabetes.

We use molecular imprinted polymer as artificial antibodies to detect breath biomarkers. Molecular imprinting is a process to fabricate a polymer matrix around a target molecule, which is subsequently removed to leave voids with high affinity.

Advantages include high sensitivity, temperature stability and low production cost. The synthesized polymer is coated on microcantilevers, which are millimeter-sized beam anchored at one end. Binding of breath molecules with their specific polymer leads to measurable mechanical responses. Breath diagnosis measures various exhaled compounds rapidly and non-invasively, thus enabling on-the-spot clinical screening.

Figure 1. Breath biomarker template (orange) self assembles with functional monomers (green). After polymerization, the template is removed from the polymer, thus leaving binding sites complementary to the template.

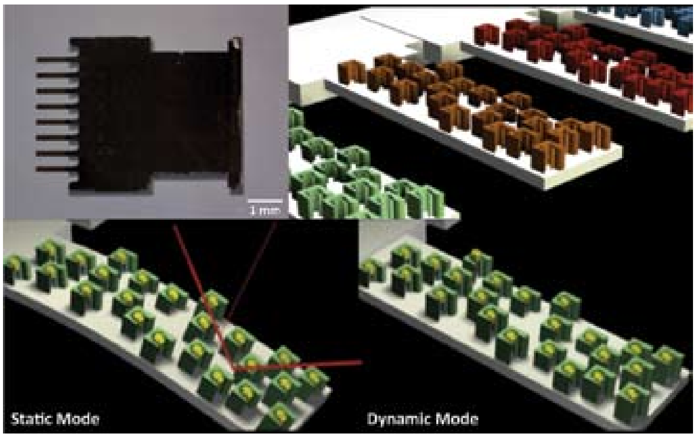


Figure 2. An array of microcantilevers coated with different molecular imprinted polymer detects various target molecules in breath. Mass loading on microcantilevers results in a detectable deflection or broadening in resonance frequency, resulting in two operation modes: static mode and dynamic mode.

Figure 3. The integration of microsensor, piezoresistive transducer, air sampling and integrated circuit systems provide a portable and field-deployable monitoring device for breath diagnosis.

Funded by Innovation and Technology Fund (ITS/436/90) and the Shun Hing Institute of Advanced Technology, CUHK (BME-8115030)

7.2 科訊廊展覽摘要

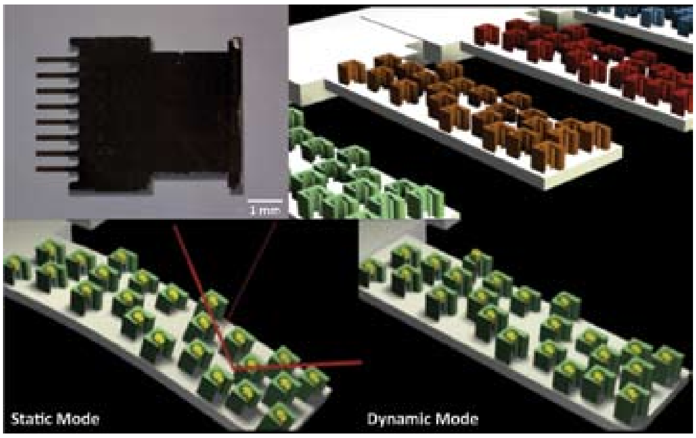
P13: 呼吸診斷

呼氣的成份包括多種氣體、水蒸氣、逾千種微量揮發性有機化合物和蛋白質分子。這些自體內產生的標記物反映人體的新陳代謝情況。例如，從呼出氣體的二氧化氮含量反映呼吸道炎症的程度，而丙酮含量則可用以監測糖尿病。

我們利用分子印跡聚合物作為人工抗體，檢測呼氣中的標記物。分子印跡技術先令印跡分子 (呼吸標記物的模板) 與目標單體，產生相互作用自動集合，並形成配合物。再在適當環境下合成聚合物，將印跡分子 (呼吸標記物的模板) 從所合成的聚合物上洗脫掉之後，聚合物基體上將留下與印跡分子 (呼吸標記物的模板) 大小、形狀相同和官能團能與之互補的納米結構。這些納米結構能夠在後續的再結合過程中，專一地與特定的印跡分子結合，完成對模板分子的選擇性識別的功能。

其優點包括高靈敏度、在更廣溫度範圍操作和低生產成本。合成後的聚合物會塗在微型懸臂電壓傳感器上，這些傳感器是一些微米大小的橫樑，其中之一端固定。當呼吸標記物和與其對應的聚合物粘合時，我們可量度懸臂上所產生之相關力學反應。呼吸診斷可以快速、非侵入性地檢測多種呼出的物質，作為即時即場的臨床檢查。

圖一. 呼吸標記物的模板（橘紅色）與功能性單體（綠色）自動集合。在聚合之後，模板會從聚合物中除去，所以留下一個可以與模板粘合互補的納米結構。



圖二. 微型懸臂電壓傳感器組合塗上不同分子印跡聚合物，與口氣中不同的目標分子結合。懸臂的重量增加會導致傳感器變位或共振變寬，因此有兩種操作模式：靜態模式和動態模式。

圖三. 研究團隊把微傳感器、壓阻式傳感器、空氣樣本和集成電路系統結合在一起，提供一個便攜式和可用於實地考察的呼吸診斷檢測儀器。

由創新科技署和香港中文大學信興高等工程研究所資助

7. Abstracts of Exhibitions

7.2 Abstracts of Exhibition Panels at Science News Corner

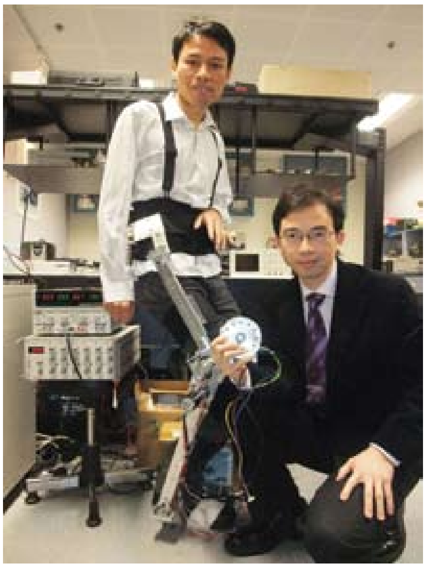
Panel 14: Assistive Knee Brace

Assistive knee braces are a kind of wearable lower extremity exoskeletons that can enhance people's strength and provide desired locomotion. It is possible to use knee braces to assist elderly or disabled people on improving their mobility in order to solve many daily life problems, such as going up and down stairs and crossing over obstacles. With a continually aging world population, devices that help elderly with mobility problems are in great need. By using assistive knee braces, patients may avoid being bedridden and will be able to maintain their physical activities. They will be able to benefit from the positive effects of exercise and enjoy an active lifestyle.

In our research, the assistive knee brace was developed by integrating a multifunctional actuator with a custom-made knee-ankle-foot orthosis. The multifunctional actuator is a novel actuator to integrate the advantages of electric motor and magneto-rheological fluids while decreasing the dimension.

This work was supported by a grant from the Innovation and Technology Commission of the Hong Kong Special Administrative Region, China (Project No. ITS/308/09).

Assistive Knee Brace



7.2 科訊廊展覽摘要

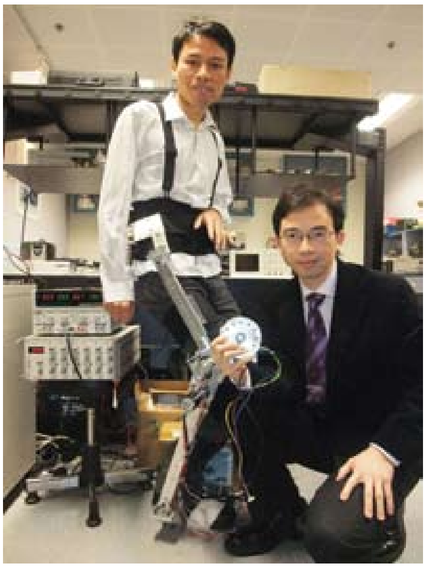
P14: 輔助護膝

輔助護膝，是一種可穿戴的下肢外生骨骼。它能增強人體的力量，協助實現自主行走。輔助護膝可幫助老年人與殘疾人士走動，因此為他們解決許多日常生活的問題，譬如上落樓梯，以及跨越障礙物。隨著世界人口不斷老化，那些能幫助老年人走動的機器有很大的需求。另外，通過使用輔助護膝，病人可避免長期臥床，維持運動機能，獲得做運動的好處及享受積極的生活方式。

我們研發的輔助護膝，是一種具有膝足矯形器的多功能驅動裝置。其中的多功能驅動裝置是一個融合了電動機與磁流變流體的優點，且同體積縮小了的新穎裝置。

這項研究得到了香港特別行政區創新科技署的資助（項目編號：ITS/308/09）。

輔助護膝



7. Abstracts of Exhibitions

7.2 Abstracts of Exhibition Panels at Science News Corner
Panel 15: CAOS Local Development

Medicine has relied on science and technology to make significant progress throughout the history. Developments in the past 10 years by the Department of Orthopaedics and Traumatology and Department of Surgery in the Chinese University of Hong Kong integrating medical imaging, navigation surgery, endoscopic and robotics technologies open an entirely new field of medical advances. These enchancing systems empower the surgeon as the accuracy and safety in the operating room can dramatically be improved. The patients were benefited by the revolutionary new research between clinical and associated industrial fields.

2001

First computer assisted navigation fracture surgery in the Department of Orthopaedics & Traumatology of Prince of Wales Hospital

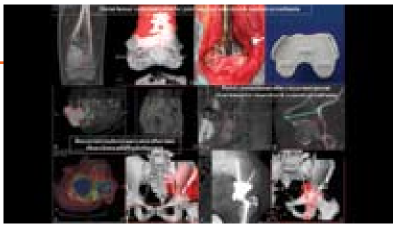
2002

First Workshop on Navigation System in Total Knee Replacement organized by the Department of Orthopaedics & Traumatology of the Chinese University of Hong Kong

2003

2004

First computer assisted navigation tumor resection and reconstruction was performed in Hong Kong



2005

2006

First Workshop-Symposium on Fluoro-navigation in Orthopaedic Trauma and Spinal Surgeries organized by the Department of Orthopaedics & Traumatology of the Chinese University of Hong Kong

2007

2008

The annual conference of the International Society for Computer Assisted Orthopaedic Surgery was held in Hong Kong. The theme of the conference was: exploring into the newer generations – surgeons, engineers, technologies and clinical applications

CAOS 2008 Hong Kong

2009

2010

Asia's first state-of-the-art Computer Assisted Orthopaedics Laboratory established by the CUHK

2011

7.2 科訊廊展覽摘要

P15: 香港電腦輔助骨科手術進程

一直以來，醫療憑藉科技而明顯進步。香港中文大學矯形外科及創傷學系及外科學系，綜合醫學造影、電腦導航、內窺鏡及機械人等技術，開拓了新的醫學前沿，令醫療及手術系統更臻完善，大大提升了手術的準確度及安全性。

2001

本港首次電腦導航骨折手術於威爾斯親王醫院進行

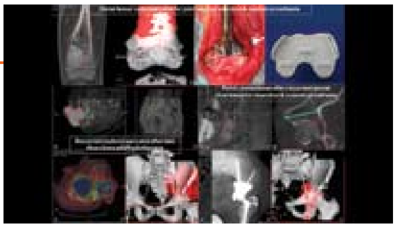
2002

本港首個導航輔助全膝置換工作坊

2003

2004

本港首次電腦輔助骨腫瘤切除及重建手術



2005

2006

本港首個透視導航骨創傷及脊柱外科手術工作坊及研討會

2007

2008

國際電腦輔助骨科手術學會年會在香港舉行。 主題為“在探索中適向新時代 — 外科醫生、工程師、科學技術和臨床應用”

CAOS 2008 Hong Kong

2009

2010

香港中文大學成立亞洲首個電腦輔助骨科手術及應用中心

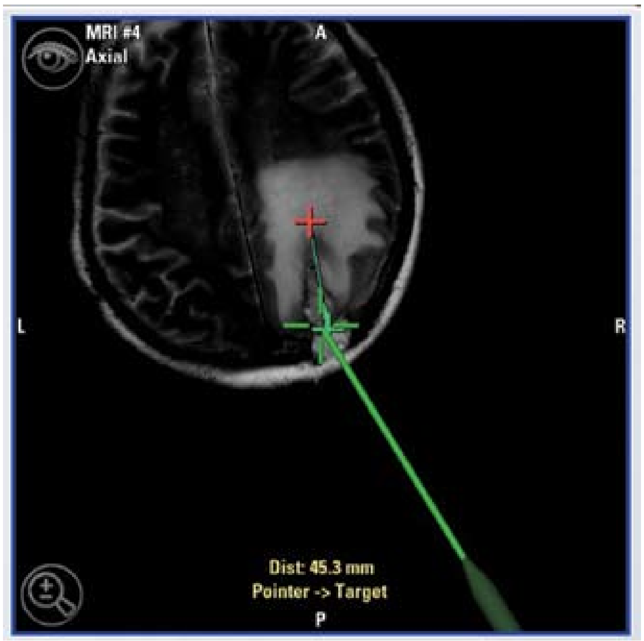
2011

8. Abstracts of Talks

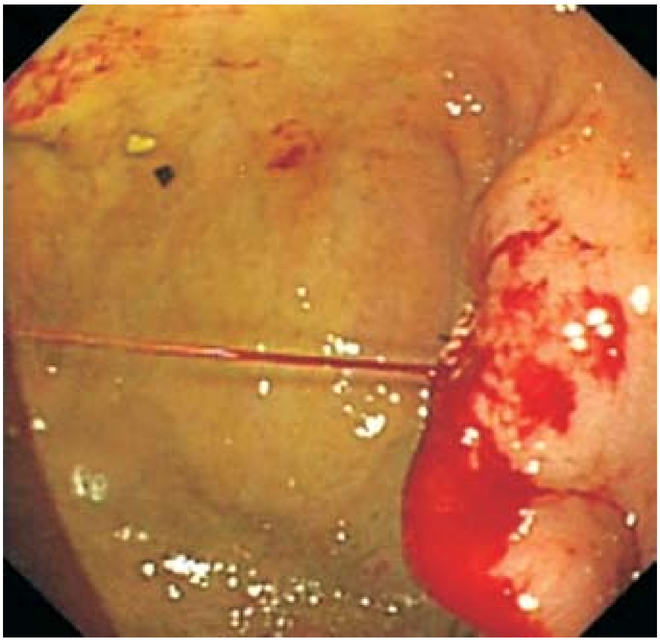
8.1 Bio-Engineering the Human Machine

Professor Douglas Yung
Department of Electronic Engineering
The Chinese University of Hong Kong

Healthcare is essential in society nowadays because of the aging population, pandemics and the quest for better quality of life. Biomedical engineering is an emerging interdisciplinary domain in which engineering and technology are applied innovatively to solve biological and medical problems for the benefit and welfare of mankind. Biomedical engineers engineer our human body by designing innovative medical instruments and sensors, deploying emerging information infrastructure, and creating new biomaterials and prosthetic devices. Examples include magnetic resonance imaging, electrocardiography, non-invasive endoscope and many others. In this talk, I will illustrate current technologies to engineer the human machine and the ways in which biomedical engineering pushes the frontier of science and engineering.



MRI Imaging



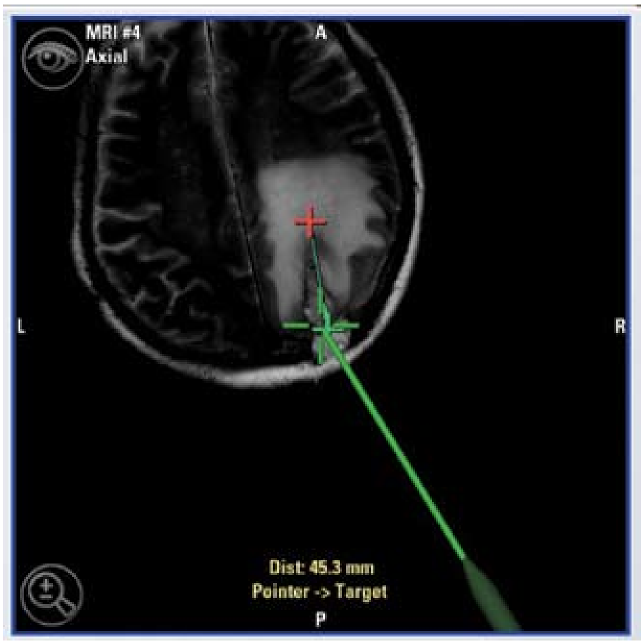
Endoscopic Image

8. 講座摘要

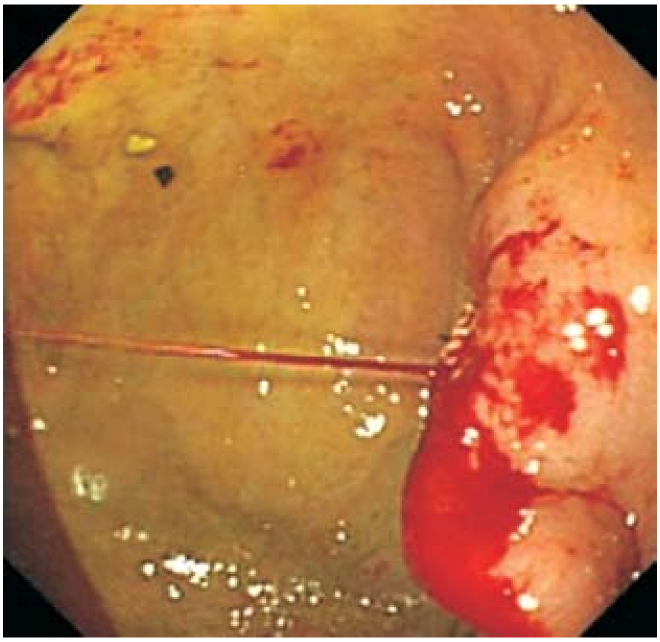
8.1 洞燭生機

香港中文大學電子工程學系
榮本道教授

人口老化、各類傳染病和優質生活的追求，使醫療保健在當今社會極為重要。生物醫學工程是一門涵蓋工程學、醫學和生命科學的誇學科課程，其宗旨是通過創新性的技術發展和應用，來加快推動醫療保健的步伐。生物醫學工程師設計新的醫療儀器和傳感器、建造新的訊息基礎設施，例如磁力共振造形技術、心電圖、非侵入性內窺鏡等，並且開發新的生物材料和假肢器官裝置，用以改善我們的人體。在此次演講中，我將會介紹現今的生物醫學工程技術，如何推動最新科學和工程學的發展。



磁力共振造影



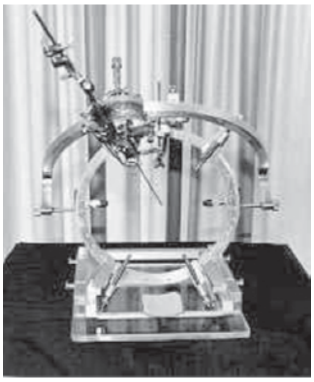
內窺鏡影像

8. Abstracts of Talks

8.2 Computer Assisted Orthopaedic Surgery – Past, Present and the Future

Professor KS Leung
Department of Orthopaedics and Traumatology
The Chinese University of Hong Kong

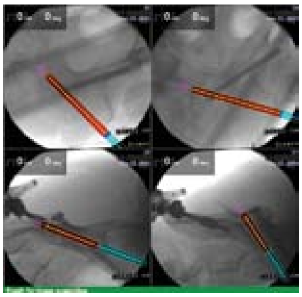
The introduction of stereotactic location of intracranial pathology in 1906 by Clarke and Horsley in neurosurgery marked the first attempt in using machine to enhance dexterity of human hands. With the advancement of technologies in 3-D imaging, e.g. Computer Axial Tomography (commonly known as CAT) in 1971, Magnetic Resonance Images (commonly known as MRI) in 1973, the general stereotaxis was greatly improved. Computer Assisted Surgery was made possible with the progress of the computer technology where VAX in 1976, Apple in 1977 and IBM Personal computer in 1981 made the application of computer stereotaxis possible. The term Computer Assisted/Aided Surgery was first used in a publication by Sohn and Robbin in the New England Journal of Medicine. It was in 1990 where 3-D tracking presented by NDI as Optotrak 3010 made the computer assisted orthopaedic surgery (CAOS) possible by providing real-time tracking of the surgical instrument in relationship to the operation site in a patient. In the past 100 years, CAS is gradually introduced to many other surgical procedures. Now CAOS is applied in spinal surgery, joint replacement surgery, fracture fixation, soft tissue reconstruction and tumour surgery.


Clarke Horsley Apparatus

In Computer Assisted Orthopaedic Surgery, the surgeon is guided by images of the bone or the anatomy defined by the surgeon in the procedure. It is similar to driving a car with navigation guide so that we can arrive at the defined destination accurately with the best route.

In the image guided navigation surgery, different types of images can be used, either alone or combined. The operation principle is:

With the spatial co-ordinates of a standard X-ray fluoroscope and the skeleton, on which the surgical procedures are going to be carried out, registered into the system, fluoroscopic images obtained intra-operatively are transferred to the navigation system with automatic scale and distortion corrections. The graphical user interface then allows the surgeon to navigate with stereotactic tools on the registered biplanar, tri-planar and multi-planar images. As these images are almost the same as those obtained from the standard C-arm, the interpretation of the anatomical features for navigation is simple and straightforward to most surgeons. Surgical procedures can thus be carried out with the virtual fluoroscope. This technique is used in fracture fixation, spine surgery and tumour surgery. The images can be simple fluoroscopic to CT for different degrees of accuracy.

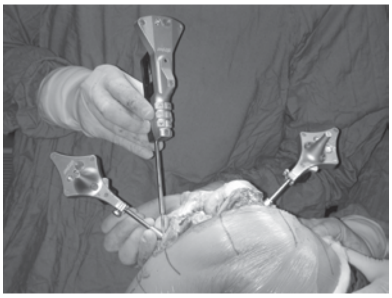

Fixation of acetabular fracture


Preoperative planning


Resection of tumor

In a surgeon defined intraoperative digitisation of the anatomy, no images are needed and the stepwise building of anatomic representations helps to build up a "map" for navigation. This technique is typically used in joint replacement surgery.

Accuracy and dexterity can further be improved with the combination of navigation and robot-assisted procedures. Different robotic designs are available for clinical use while there are plenty of room for improvement with this combined technology in orthopaedic surgical applications.


Navigation guided knee replacement

While CAOS is getting acceptance by orthopaedic surgeons, the human-machine interface and interaction open up plenty of rooms for improvement. If this technology is going to improve further the patient care, a paradigm shift in the application workflow must be implemented with the help of the information and automation engineering to enhance:

1. Quantitative diagnostic studies
2. Preoperative planning and trials
3. Precise operative execution
4. Postoperative specific assessments
5. Guided and programmed rehabilitation
6. Objective clinical assessments
7. Evidence-based practice

The comprehensive application of CAOS will not focus only in surgical procedures, the concept of the CAOS should evolve to include:

1. Preoperative planning and feasibility trial
2. Intra-operative assistance and automation
3. Postoperative assessments and rehabilitations
4. Teaching and training of young surgeons

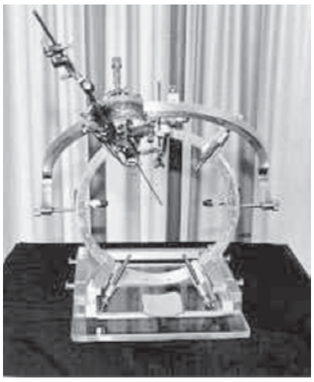
CAOS should stand for Computer Assisted OrthopaedicS

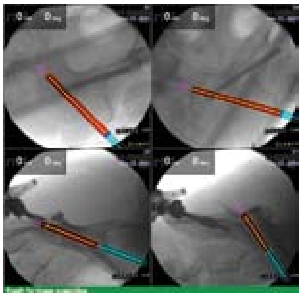
8. 講座摘要

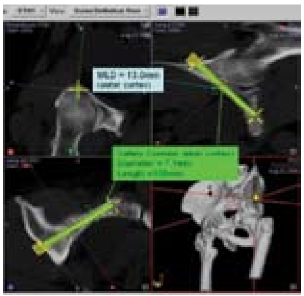
8.2 電腦輔助骨科手術——昨天、今天與明天

香港中文大學
矯形外科及創傷學系
梁國穗教授

1906年，腦神經外科專家霍斯利與克拉克開創了立體定位技術在腦科手術的應用，標誌著人類首次將人工裝置運用於手術輔助中，以提高人手操作的精準度與靈活性。1971年，電腦斷層掃描（CT）問世；1973年，磁力共振掃描（MRI）誕生。這些先進三維造影技術的迅速發展，使立體定位水準大大提高。隨著電腦技術的不斷進步，VAX、Apple、IBM個人電腦公司先後於1976、1977與1981年在電腦立體定位技術有突破性的發展，奠定了電腦輔助外科手術的研發基礎。“電腦輔助手術”一詞首次出現於Sohn與Robbin發表在《新英格蘭醫學雜誌》的文章中。1990年，NDI公司應用Optotrak 3010展示了三維追蹤技術，提供外科器械在手術部位的即時追蹤，為研發電腦輔助骨科手術（Computer Assisted Orthopaedic Surgery, CAOS）的重要里程碑。在既往的100年中，電腦輔助手術技術（CAS）逐漸推廣到其他外科。如今，CAOS已被廣泛應用於脊柱、關節置換、骨折固定、軟組織重建以及腫瘤手術等領域。


克拉克與霍斯利儀


電腦導航髖臼骨折手術


手術前計劃

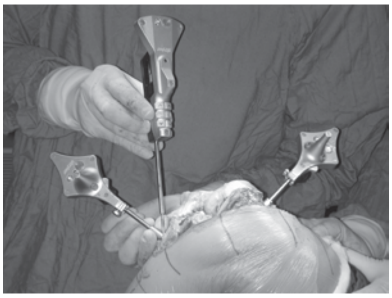
在電腦輔助骨科手術中，醫生經由骨組織或其他自定的解剖結構的影像指引，進行手術。此舉如同在汽車導航儀的引導下駕駛，我們可以遵循最佳的路線準確地抵達目的地。

在影像導航手術中，醫生可單獨或聯合應用不同種類的掃描影像。其操作原則是：

手術前，預先將標準X光透視機及病人手術位置的骨骼進行空間配準，並導入系統。經由電腦自動比例及變形校正，手術中的透視影像被轉換入導航系統。隨後，在電腦屏幕上，醫生通過立體定位工具在已導入的雙平面、三平面及多平面的圖像上進行導航操作。由於這些圖像與一般手術用的C型臂所造影像近乎相同，大多數外科醫生可簡單明瞭地進行定位導航，實現在虛擬透視影像下的相關手術操作。目前，此技術已被應用於骨折固定、脊柱及腫瘤手術之中。出於不同手術精度的需要，亦可將簡單透視轉為CT掃描。


骨腫瘤切除手術

在非影像導航手術中，醫生無需採用上述影像，而是將解剖數位化，經由分段建立的解剖學座標及表面特徵協助合成導航“地圖”。此技術主要運用於關節置換手術。


電腦導航關節置換手術

通過聯合應用導航定向及機械人技術，醫生進一步提高手術的精準度與靈活性。目前，已有多種機械人設計方案投入臨床實踐，同時，該聯合技術在骨科手術中依然存在廣闊的發展空間。

如今，CAOS日趨為骨科醫生所廣泛採用，為了進一步為病人提供更完善的服務， 在資訊及自動化工程的輔助下，操作流程需作出針對性的改良，從而進一步提高CAOS的臨床應用：

1、定量化診斷研究
2、手術前計劃及預試驗
3、手術中精準化操作
4、手術後專業性評估
5、指導性及計劃性康復訓練
6、客觀性臨床評估
7、循證醫學指導

廣義而言，CAOS的概念不僅僅局限於手術操作，而應涵蓋以下幾個層面：

1、手術前計劃及可行性試驗
2、手術中輔助及自動化
3、手術後評估及康復訓練
4、年輕醫生的教學培訓

故此，將CAOS理解為Computer Assisted OrthopaedicS（電腦輔助骨科學）更為妥當。

8. Abstracts of Talks

8.3 Development of Upper GI Surgery: from minimal to non-invasive approach

Professor Philip WY Chiu
Department of Surgery, The Chinese University of Hong Kong

Over the past 20 years, the management of upper GI (Gastrointestinal) diseases was revolutionized by the concept of minimal invasive surgery and endoscopy. 30 years ago, gastrectomy was the most commonly performed upper GI surgery for the management of peptic ulcer and its complication. With the discovery of Helicobacter pylori and the development in endoscopic therapies, there was a paradigm shift in the management of peptic ulcer disease from primary surgery to endoscopy.

Management of upper GI cancers then became one of the most important tasks for upper GI surgery. The incidence of upper GI cancers remained high in the Asia Pacific region, with gastric cancer being the second leading cause of cancer death in Asia while squamous esophageal cancer is associated with extremely poor prognosis.

Esophagectomy and gastrectomy was the standard curative treatment for cancer of esophagus and stomach respectively. With the advancement in technologies, these surgeries can now be performed under minimal invasive approaches. Minimal invasive esophagectomy and gastrectomy resulted in similar oncological clearance, but achieved significantly better perioperative outcomes including reduced pain and hospital stay. Recently minimal invasive surgery is enhanced with the development of Robotic assisted surgery, and the Chinese University of Hong Kong first introduced Robotic assisted minimal invasive surgery in 2005. Now, we have successfully performed the first series of robotic assisted esophagectomy.

For early stage upper GI cancers without risk of lymph node metastasis, endoscopic resection served as a feasible non-invasive treatment. With the development of new high definition endoscope, fine endoscopic instruments and energy platforms, endoscopic submucosal dissection (ESD) became possible which can achieve large area of resection for early GI cancers. When compared to minimal invasive surgery, ESD accomplished similar oncological results without abdominal incisions or resection of the organ. Without wounds and anastomosis, patients' recovery was hastened. Our unit is the first in Hong Kong to perform ESD for treatment of early GI cancers since 2004, and now more than 250 patients had already benefited.

The concept of Natural Orifices Transluminal Endsocopic Surgery (N.O.T.E.S.) first proposed the concept of performing surgery without skin incisions. This concept led to the development of Per-Oral Endoscopic Myotomy (P.O.E.M.) for treatment of esophageal motility disorders. This is a non-invasive approach to perform myotomy through a mucosal incision and submucosal tunneling. The future of upper GI surgery is moving from minimal invasive to non-invasive approaches through further development and technological breakthroughs in robotics and endoscopy.

Fig 1: Long open wound after conventional esophagectomy
圖一：傳統食管切除手術後的大傷疤

Fig 2: Small wounds for minimal invasive esophagectomy
圖二：微創食管切除手術後的小傷疤

8.3 上消化道手術的發展：從微創至無創

香港中文大學外科學系
趙偉仁教授

在過去二十年來，上消化道疾病的治療因微創手術和內鏡的概念而有革命性的轉變。三十年前，胃切除術是治療消化性潰瘍及其併發症的最常用方法。隨著幽門螺桿菌的發現和內鏡治療的發展，治療消化性潰瘍的模式有所轉變，由主要用手術切除變為使用內鏡治療。當潰瘍已由內鏡及藥物治療取代，上消化道癌症治療便成為上消化道外科一項最重要的任務。上消化道癌症在亞太地區的發病率仍然很高，胃癌是亞洲第二大癌症死亡原因，而鱗狀食道癌即預後極差。食道切除術和胃切除術分別是治療食道癌和胃癌的標準治療。隨著技術進步，這些手術現在已採取微創方法進行。微創食道切除術和胃切除術在腫瘤清除方面已能達到開放式手術同等效果，而微創手術更能顯著地減少術後疼痛和住院時間。最近微創手術因機械人輔助手術的發展得以加強。在2005年，香港中文大學率先引入機械人輔助微創手術。現在，我們已在亞州地區率先成功完成了機械人輔助食道切除手術。

對於沒有淋巴結轉移風險的早期上消化道癌症，內鏡下切除是一種非侵入性的治療方法。隨著嶄新高解像內鏡、精細的內鏡手術儀器和優良能源平台的發展，內鏡黏膜下剝離術（ESD）成為可以實現大面積早期消化道癌症切除的方法。與微創手術相比，內鏡黏膜下剝離術（ESD）能在早期腸胃癌清除方面達致相等的效果，其相對的優點是沒有腹部切口和無須作器官切除。因為沒有傷口及吻合口，能促進病人的康復，術後病人亦沒有器官切除所帶來的後遺症。自2004年起，中文大學醫學院率先在香港和中華地區首先進行內鏡黏膜下剝離術（ESD）來治療早期消化道癌症，直至現在已為超過250名患者完成早期腸胃癌治療。

經天然孔道內鏡手術（N.O.T.E.S.）為醫學界注入一種新的研究概念 — 就是一種嶄新的、無創、無切口手術。這種觀念引發了大量研究，而最成功的例子是經口內鏡食道賁門切開術(P.O.E.M.)治療食道功能失調症。這是一項非侵入性的方法來進行食道環形肌切開，其切口通過粘膜和粘膜下隧道進行。通過機械人技術和內鏡技術的發展，未來將有更多的上消化道手術能在技術上得到突破，從微創發展至無創方式進行。

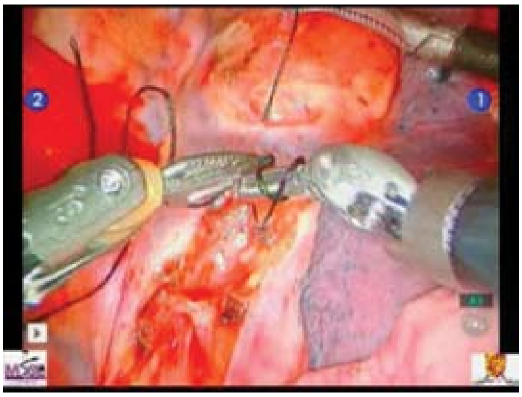


Fig 3: Robotic esophagectomy
圖三：機械人輔助食管切除手術

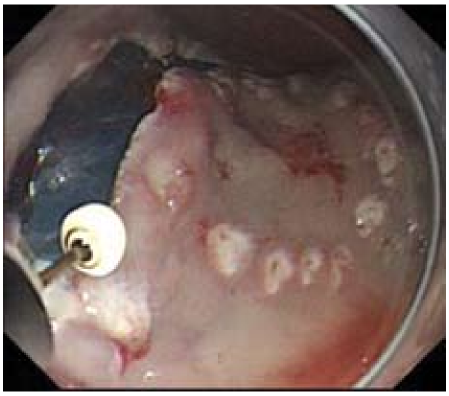


Fig 4: Endoscopic submucosal dissection for treatment of early gastric cancer
圖四：內鏡黏膜下剝離術（ESD）治療早期胃癌

8. Abstracts of Talks

8.4 Robotic Assisted Urology Surgery

Dr Joseph Wong
Division of Urology, Department of Surgery
Prince of Wales Hospital

Robotic-assisted surgery was first performed in 1988. In the past 20 years there is ever increasing application of this technology. The first machine in Hong Kong was installed in the Chinese University of Hong Kong/ Prince of Wales Hospital and it was sponsored by the Hong Kong Jockey Club and Kai Cheong Tong Foundation. We performed the first robotic-assisted surgery in the same year in a patient that required partial nephrectomy. This machine was named "daVinci®", mainly as an attribute to Leonardo di ser Piero da Vinci, an Italian Renaissance polymath. Leonardo not only a famous artist, sculptor, musician, etc; he is also revered for his technological ingenuity with sketches of a "robot-like" machine found. Although his design could not be put into practical use at his times, but they provide innovative ideas for furture development.. The advantages of the machines are their patented Endowrist with six-degree of movement, which allow greater flexibility of fine movement and their 3-dimension (dual channel endoscopy) with magnified view. Surgery could therefore be performed in a more precise way and there are also ergonomic advantages for the surgeon. These features are important such that patients' surgical outcome improve. There is in general less blood loss, and hence less need and potential complications of transfusion; the recovery of patients also hastens with less complications (e.g., for prosatectomy, rates of urinary incontinence and sexual dysfunction also decrease) and the prognosis after tumor surgery also improve, probably related to clearer resection margin with precision. This technology has been applied widely in urological surgeries, including prostatectomy, bladder resection, pyeloplasty, partial nephrectomy and ureter surgery, etc. Our center operates with this "robot" on ~60 cases every year on average and the overall surgical outcome was satisfactory. The application of this technology is also expanding to gynecological surgery, general surgery, etc.


Robot for urology surgery


Setup of robot assisted surgery system in operation room

8.4 機械人輔助泌尿外科手術

威爾斯親王醫院泌尿外科
黃翰明醫生

機械人輔助手術的應用自1988年至今已有二十多年的歷史，在香港則於2005年在香港賽馬會和繼昌堂基金贊助下安裝了全港首部達文西機械人，並於同年進行了第一次試驗性腎局部切除手術。達文西是文藝復興時期一位知名的藝術家，也是一位出色的數學家和科學家，在他的手稿中發現疑似機械人的草稿，雖然在他的年代未能將其設計付諸實行，但卻為後人給了不少啟蒙的作用。機械人輔助手術的特色，在於其專利的「手腕」技術，提供六個角度的移動，使機械臂的動作更靈活精確， 同時提供雙鏡頭三維景深和高解象的視覺效果。其應用在狹窄的手術空間中尤其有利，而且醫生亦可在較符合人體力學的環境下進行手術。最重要的是病人的手術效果也有明顯改善：手術中失血減少，也因此減少了輸血的需要和風險；病人的術後康復也更快，以前列腺手術為例，小便失禁和勃起功能障礙也減少；而且治療一般腫瘤的效果也較理想（能更準確地切除腫瘤以減少復發）。在泌尿外科而言，這技術已應用於前列腺切除、膀胱全切除、腎盂整形術、腎局部切除和輸尿管手術等。現時香港中文大學威爾斯親王醫院每年平均進行約六十個機械人輔助外科手術，整體的手術後結果也是理想的。目前這項技術也開始應用在其他外科手術中，如婦科手術、普通外科手術等。


泌尿外科手術機械人

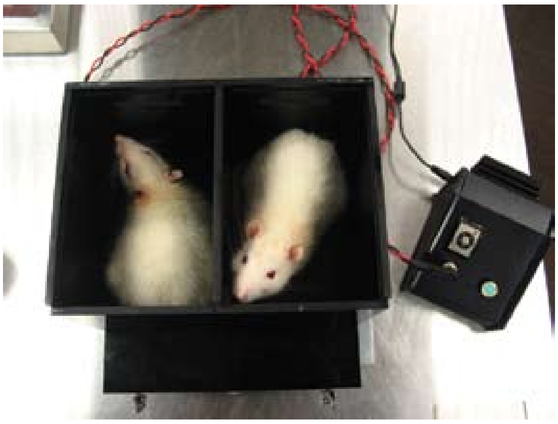

設置機械人輔助手術系統

8. Abstracts of Talks

8.5 Interactive Weight-bearing Exercise (iWE) Technology – From Research to Application

Professor Louis Cheung
Department of Orthopaedics and Traumatology
The Chinese University of Hong Kong

Interactive Weight Bearing Exercise (iWE) provides low-magnitude high-frequency vibration signals at 35Hz and 0.3g (g is gravitational acceleration), which is a non-invasive biophysical intervention to provide systemic vertical mechanical stimulation to the musculoskeletal system. We are the first group to investigate the effect of iWE on fracture healing in rat model that confirms an acceleration of fracture healing by 30% through enhancing bone formation and remodeling. The intervention also enhances blood flow and new blood vessel formation at fracture site. We are now undergoing a clinical trial to verify its clinical efficacy on osteoporotic fracture healing. To date, the results are encouraging and most importantly, it is safe for fracture patients. This finding will be revolutionary to future management of fracture healing. Besides, our group is also conducting a large-scale clinical trial involving 704 postmenopausal women to evaluate the effects of iWE on reducing fall and fracture rates. Our latest results indicate iWE can reduce fall rate significantly by about 32% than control group, with increased muscle strength, functional outcomes and balancing ability. All these multifactorial beneficial effects of iWE suggest that iWE may be useful for patients with neuro-muscular diseases, e.g. post-stroke rehabilitation. We will certainly explore further applications of iWE on other musculoskeletal indications in the future.



iWE study on animals

Treatment on bone fractured patient

Large-scale trial at elderly community centre

Trial at community centre

8.5 互動負重運動科技—從學術研究到實踐

香港中文大學
矯形外科及創傷學系
張穎愷教授

互動負重運動（iWE），是一種非入侵式的生物物理治療，為全身骨骼肌肉系統提供高頻率和低幅度的垂直振動刺激（每秒35次及0.3g）（g是重力加速度）。香港中文大學是首個在老鼠實驗中研究iWE功效的科研團隊，研究結果顯示，iWE通過增加骨的形成及骨結構的重塑，使骨折癒合的速度加快了30%。同時，iWE能加快骨折部位的血液循環以及新血管的形成。我們正進行臨床試驗以確定iWE在骨質疏鬆所導致的骨折癒合的功效，目前研究結果令人振奮，最重要的是iWE對於骨折病人來?是安全的，這對於骨折癒合的治療，將是革命性的發現。除此以外，我們的科研團隊正進行一項大型的臨床研究，以704名停經婦女作?研究對象，評估iWE對於減少跌倒及骨折的機會率。最新的研究結果顯示，相對於沒有接受iWE治療的對照組，iWE透過增強肌肉力量、功能及平衡能力，大大降低了跌倒的機會達32%。這些結果表明，iWE能加快罹患神經肌肉疾病如中風患者的康復。我們將來會探索更多iWE在其他骨骼肌肉上的應用。


老鼠實驗


治療骨折病者


大型社區研究


社區中心試用

8. Abstracts of Talks

8.6 Navigation Assisted Neurosurgery: Brain Tumor Surgery

Professor George Wong
Division of Neurosurgery, Department of Surgery
The Chinese University of Hong Kong

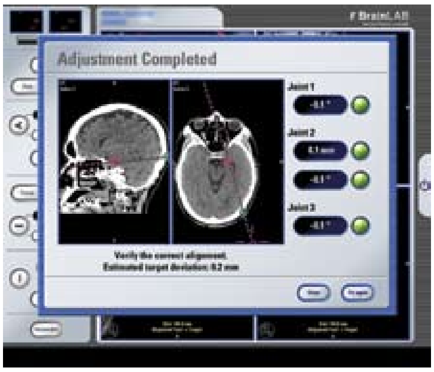
Horsley and Clark first reported stereotactic operations in animals in 1908. Almost 40 years later, Spiegel et al. introduced the stereotactic method into clinical use. The use of stereotactic techniques increased with the advent of CT scanning and MRI.

In 1986, Roberts et al. reported the development of a frameless, computer-based system for the integration and display of CT image data with the operating microscope. A frameless, armless, navigational system was based on a three-dimensional digitizer to determine the spatial position of the instruments. The adapters are simply screwed onto surgical instruments, e.g., bipolar forceps, suction tubes, endoscopes, and catheters. In this way, many surgical procedures can be performed with this navigation system.

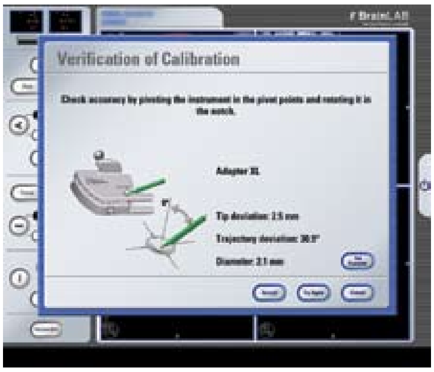
We use the neuronavigation system in our department for operations including brain tumor surgery and endoscopic procedures, e.g., catheter placement into cerebral cysts and puncture of very small ventricles, as well as biopsies of larger (>2-cm diameter) lesions. The time required for data transfer, delineation of the lesion, and reconstruction is approximately 10 minutes. The system can be easily operated; no specially trained technician is needed for preparation and reconstruction of the data. The marker registration can be performed in a sterile or non-sterile fashion. Another advantage of the neuronavigation system lies in the combination with the operating microscope. After the marker frame is mounted, all microscopes equipped with a serial computer interface can be used as a pointer with the navigation system. The navigation system is very useful for planning the surgical approach.

The skin incisions and craniotomies are smaller than without the system. Using virtual planning of the trajectory, we never performed an exploration with negative results. The system is also very useful for surgical treatment of cranial base lesions. In this area, the shift is not important and does not decrease the accuracy. Even for large cranial base lesions (for example, olfactory groove meningiomas), the navigation system proved to be helpful for determination of the position within the tumor and for calculation of the distances to important structures. In our experience, neuronavigation brings us forward in the concept of minimal access neurosurgery and has shortened the hospital stay of our patients.

初步調整手術位置
Coarse adjustment of surgical position



虛擬手術定位完成
Virtual adjustment of surgical position completed



核實校準
Verification of calibration

8.6 導航輔助腦外科手術：腦腫瘤手術

香港中文大學
外科學系腦外科
黃國柱教授

在1908年，霍斯利與克拉克首次發表了在動物身上進行立體定向手術。40年後，Spiegel等人將立體定向方法引入到臨床應用。隨著電腦斷層掃描技術和磁力共振造影技術的發展，立體定向手術得到了廣泛的應用。

在1986年，羅伯特等人的研究，向公眾展示了以電腦為基礎的無框架導航系統的發展。此系統結合手術顯微鏡，整合及顯示斷層掃描的圖像數據。無框架無機械臂導航系統，基於三維空間的定位技術，透過預先嵌入的紅外線感應器，決定手術儀器的位置。這些被嵌入感應器的手術儀器，一般包括雙極鉗、吸管、內窺鏡和導管。現今，此導航系統已應用於許多外科手術當中。

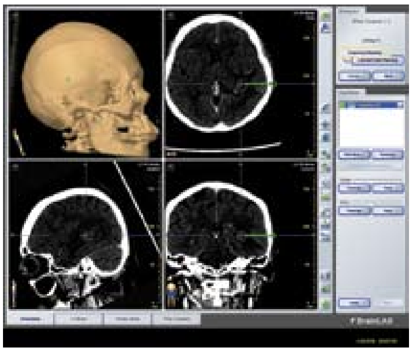
除了腦腫瘤手術和內窺鏡手術，我們亦將神經導航系統應用於其他腦外科手術，如把導管放入腦囊腫位置、抽取直徑大於兩厘米的病變組織等。數據傳輸、病變位置的確定以及圖像重組需時約十分鐘。確認標記的步驟不一定在非無菌條件下方可進行。神經導航系統的另一個優點是與手術顯微鏡結合使用。當固定各個標記後，所有裝配有相關電腦導航界面的顯微鏡都可用作導航的指示點。

皮膚切口和顱骨切口會比較小。使用虛擬技術作手術規劃，在過程中不會出現負面的效果。

導航系統有助於手術策劃，對於顱底損壞的外科治療也非常有效。即使是大面積的顱底病變，例如嗅覺神經溝腦膜瘤，導航系統能計算出腫瘤的位置及與周邊重要器官的距離。從經驗得知，神經導航為我們引入了微創神經外科的概念，並且縮短了患者住院的時間。

導航系統整合及顯示電腦斷層掃描與磁力共振造像的數據
Neuronavigation system integrates and displays CT and MRI image data

電腦導航抽取腦腫瘤組織樣本手術
Navigation assisted brain tumor surgery for extraction of biopsy



航跡規劃
Trajectory planning

抽取組織樣本
Taking biopsy

8. Abstracts of Talks

8.7 Wearable Systems and Their Applications on Cardiovascular Diseases

Professor Carmen C. Y. Poon and Professor Y. T. Zhang
Joint Research Centre for Biomedical Engineering,
Department of Electronic Engineering,
The Chinese University of Hong Kong

Despite the enormous efforts dedicated to prevent cardiovascular disease in the past years, it has remained the primary cause of mortality in most countries. New strategies are thus urgently needed to effectively identify asymptomatic patients who are at high-risk of acute CV deaths. Acute CV events are believed to be resulted from the interaction between a substrate, i.e. the development of vulnerable plaques during atherosclerosis, and a trigger that leads to the final dynamic event, i.e. the rupture of the vulnerable plaque. While the presence of vulnerable plaques have to be better identified by new multi-modal imaging, blood test and genetic markers, near-term prediction of the occurrence of the final dynamic event will require information supplied from wearable systems.

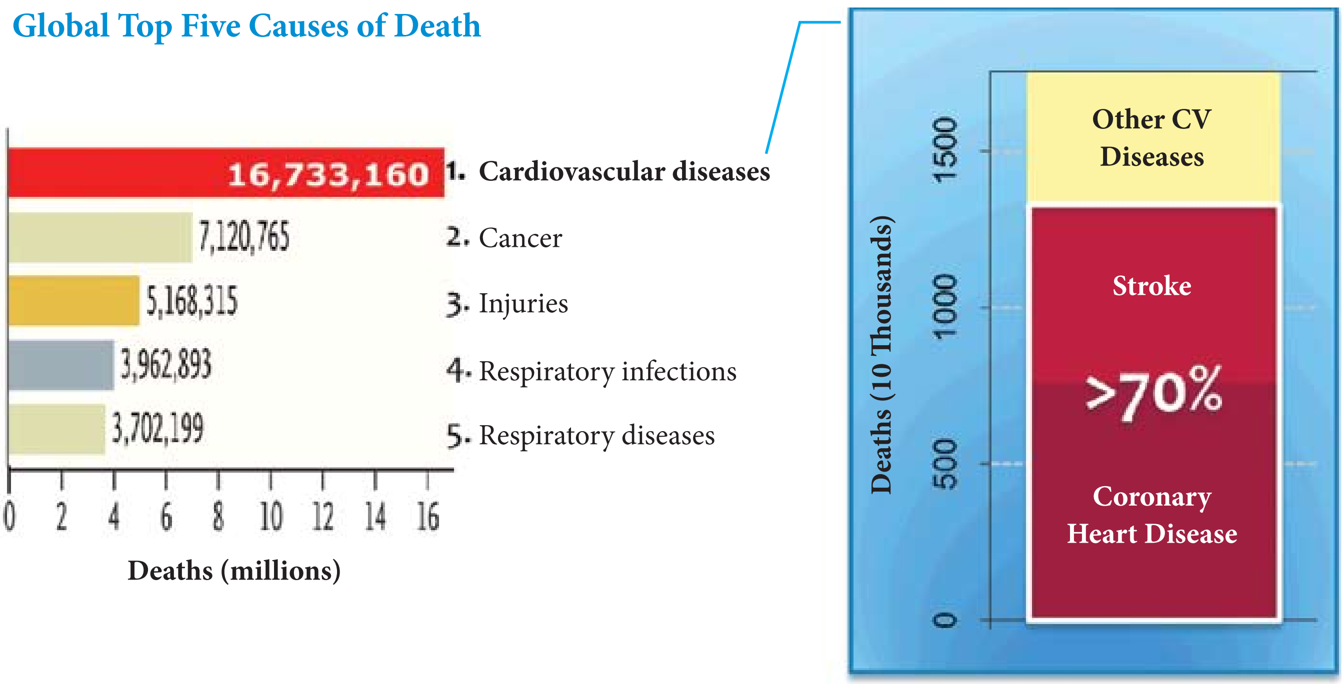


Fig. 1. Global top five causes of death. Despite the enormous efforts dedicated to prevent cardiovascular disease (CVD) in the past years, CVD has remained the primary cause of mortality in most countries. Every year, about 12 million people throughout the world die of a heart attack or a stroke. Nearly two-thirds of people who have a heart attack die before they can reach medical care. Even when stroke patients have access to modern, advanced treatment, 60% die or become disabled.

Ref: 1) WHO Statistics, estimated total deaths by cause, 2002.
2) Confronting Chronic Disease in Countries with Low Income, N Engl J Med, 2007, **356**: 209–211.
3) WHO, "Avoiding heart attacks and strokes", 2006.

8.7 穿戴式保健系統及其在心血管疾病上的應用

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儘管在過去幾年裏面，大部分國家為預防心血管疾病付出了巨大努力，但它仍然是導致死亡的首要原因。急性心血管問題相信是動脈在粥樣硬化中出現的易損斑塊破裂引起。要預防急性心血管問題，除了需要借助新型的造影技術、血液測試與遺傳標記外以檢測易損斑塊的出現、血凝結的可能性，穿戴式系統亦可提供斑塊破裂或心肌異常等相關動態信息，以作急性心血管事件的近期預測。

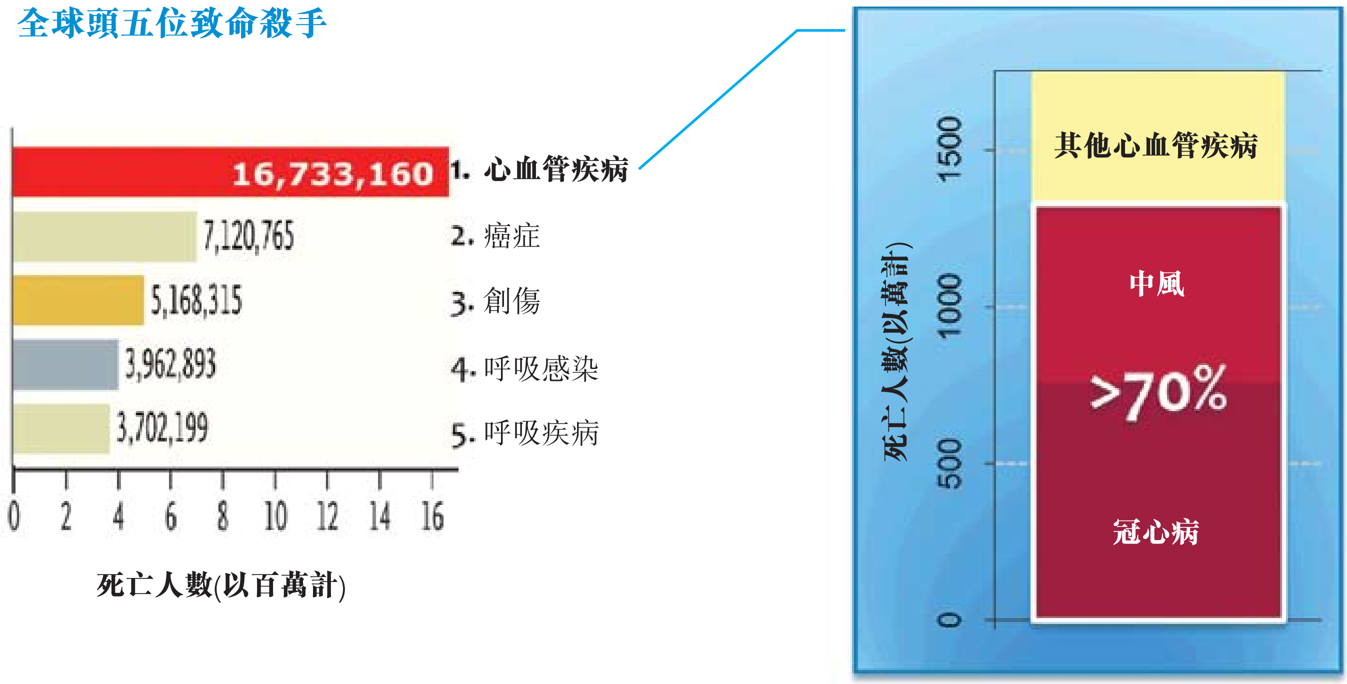

圖1.　全球頭五位致命殺手。儘管在過去幾年裏，大部分國家為預防心血管疾病付出了巨大努力，但它仍然是導致死亡的首要原因。每年，全球大約有1200萬人因心臟病突發或中風而死亡。接近三分之二的人在得到救治前，因心臟病突發而死亡。即使中風病人得到現代的先進治療，仍有60%的病人因此而死亡或導致殘疾。

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