國立臺灣大學生醫電子與資訊學研究所

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國立臺灣大學生醫電子與資訊學研究所 BEBI Annual Report, No. 5 / Sep. 2011

國立臺灣大學
生醫電子與資訊學研究所

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序言 Preface

在過去一年中，我們持續地推動生醫電資跨領域的研究與教學工作。其中在師資方面，特別合聘光電所孫啓光教授加入本所陣容，以提昇本所在光電生物醫學工程的研究能量，孫啓光教授的專長主要是飛秒光學、超快現象、生醫非侵入式光學奈米影像與操控、超高頻寬光電、奈米超音波，其研究成果非常傑出。

此外我們也舉辦了第五屆台大生醫電資營，本活動的主要對象是國內各系所之大學生及研究生，本活動報名踴躍，人數遠遠超過預期，顯見經過了連續五屆的活動舉辦，本所推動的跨領域學習已獲得共鳴與成效。我們也跟中華民國資訊學會及國立台灣科技大學電子工程系共同主辦第二屆全國生醫電子與資訊專題實務競賽，今年的主題為「科技醫學新世代」，活動目的：為鼓勵生醫電子與資訊相關科系之大學院校學生，利用所學之生醫、電子、資訊、網路等技術進行跨領域的合作與整合，進行生醫量測、遠距醫療、居家照護、健康管理、醫療輔助相關之系統的設計與應用，以增進學生的學習興趣並培養其實務能力。同時希望學生在產品設計時就可以考慮產品之實用性與便利性，以提升我國在生醫電子與資訊相關產品之設計能力。

各項所務工作的推展需要持續不斷、與時俱進。在此理念之下，我們落實執行跨學門課程改善計畫，將本所現有之基礎與核心課程，透過各項資源的支持，持續改善，提升教學成效。此外，以所上教師既有之優異研究成果為基礎，加強推動整合性研究，向校內外爭取研究經費，也是重點推動的工作。

為了持續提昇本所教學的品質，我們申請IEET工程及科技教育認證，並於去年三月通過認證，在師資、教學、研究、經費及設備上的表現均獲得非常好的評價。另外，本所也與工研院共同舉辦2010 遠距健康照護國際研討會-突破、永續、新世紀。增加本所在醫學資訊研究的國際地位及知名度。

本所成立至今已五年，非常感謝大家的努力及團隊合作，我們希望所有同仁都能積極參與所務，共同合作執行計畫，對外更要加強學門間的合作關係，讓本所研究成果能夠成為亞洲的標竿。生醫電資領域的研究從沒有像今日這樣充滿史無前例的機會及挑戰，讓我們攜手並進，勇於承擔這個偉大的使命及責任。

賴飛羆

2011年9月

In the past year, promoting multidisciplinary research and teaching in the areas of Biomedical Electronics and Bioinformatics continued to be our main mission. Prof. Chi-Kuang Sun joined our institute. The related research interests of Prof. Sun include femtosecond Optics, ultrafast phenomena, noninvasive optical microscopy and manipulation for biomedicine, ultra-high bandwidth optoelectronics, nano ultrasonics. With the addition of a new faculty member, we are sure that the multidisciplinary research and teaching efforts can be better integrated and consolidated.

We also held the fifth annual NTU Biomedical Electronics and Bioinformatics Camp. The target recipients of this event are undergraduate and graduate students regardless of their academic backgrounds. As it turned out, the number of attendees far exceeded our expectation and this encourages us to continue to fully support this annual event in the future. We work together with IICM and NTUST to sponsor the Second National Biomedical Electronics and Bioinformatics Project Competition to encourage students to design and implement a solution to the problems of healthcare.

As part of the continuing efforts towards research and teaching excellence, we have also been executing a cross-disciplinary curriculum improvement project. Under this project, the six core courses in biomedical electronics and bioinformatics at both undergraduate and graduate levels will be re-examined and refined. On the other hand, by seeking research funding from both government and industry, we continued to promote integrated research projects that aim to address important biomedical problems.

In order to keep promoting our teaching quality, we applied for the accreditation of engineering and technology education programs from The Institute of Engineering Education Taiwan (IEET). In the March 2010, we received a pass approval. We have very good reputation and performance in the review categories of faculty, teaching, research, funding and equipments. We and Industrial Technology Research Institute (ITRI) together held 2010 International Conference on Sustainability and Scalability of Disruptive Telehealthcare Solutions at Taipei last November. Through this effort, it helped to promote the international reputation of our distinguished researches in medical informatics.

As always, we are very thankful for all the supports that we have received. It has been five years since our institute was founded, and we had opportunities to recruit new staff members and expanded our office space. With these, we hope that all the faculty members can do joint projects and have more cooperation in the teaching and research activities. Together we are heading to be a leading biomedical institute in Asia. These have never been such an opportunity and challenge lie ahead of us. Let us march ahead hand in hand together to fulfill this great mission and responsibilities.

Feipei Lai

September, 2011.

目錄 Contents

壹 生醫電子與資訊學研究所簡介
Introduction of BEBI

國立臺灣大學生醫電子與資訊學研究所（簡稱生醫電資所）於2006年8月1日正式成立，本所的獨特性在於生物醫學、電機與資訊三大領域的結合，進行生物醫學之前瞻研究及跨領域教學。換言之，生醫電資所的主要使命在於提升跨領域的研究及教學，以因應生物醫學科技的快速發展，這些領域有：生醫電子、分子/細胞/組織影像、生醫訊號處理、生醫光電、感測器、微陣列分析、電腦輔助診斷、生物資訊學、系統生物學以及醫學資訊學等，為了在此專業領域中追求卓越，並謀求進一步的研究合作，整合來自不同領域的專業是相當必要的。

2006年8月，生醫電資所開始招收博士班，目前每年招收18名博士生加入生醫電資所的行列，碩士班也於2007年8月開始招生，每年有42名碩士新生加入。本所有36位教師，來自不同領域的背景，包含了電機工程、資訊科學、生物、藥學、生醫工程、醫學以及生命科學。本所的課程設計也提供學生有足夠的跨領域訓練，以迎合生物醫學科技此一領域的挑戰，目前，我們針對重要的生醫問題進行整合性的研究，同時也和生醫電子及生物資訊相關產業合作，及進行跨領域的訓練和教育，我們期待本所持續的成長茁壯，並對生物科技與健康照護領域做出貢獻。

The Graduate Institute of Biomedical Electronics and Bioinformatics (BEBI) at National Taiwan University was formally founded on August 1, 2006. In a way, it is a very unique institute among those in College of Electrical Engineering and Computer Science, National Taiwan University, in that the fields of expertise are diversified but our efforts remain extremely focused. The main mission of the institute is to promote multi disciplinary research and education in respond to the rapid advancement of biotechnology. In this regard, the following areas have been identified as our focus areas which we have been putting our major efforts in: biomedical electronics, molecular/cellular/tissue imaging, biomedical signal processing, biophotonics, sensors, microarrays, computer aided diagnosis, bioinformatics, systems biology and medical informatics. To excel in these areas and to bring up research synergy, integrative efforts from different disciplines are necessary.

The BEBI institute started the doctoral program in August, 2006 and now we admit 18 new Ph.D. students every year. Our master program started in August, 2007 with 42 new students entering the institute annually. There are 36 faculty members, among those 8 are with primary appointments. As our main mission mandates, our faculty members come from different trainings, including electrical engineering, computer science, biology, pharmacy, biomedical engineering, medicine and life sciences. Our curriculum is also designed to provide students with sufficient cross-disciplinary training to meet the challenges in biotechnology. Currently resources are used to promote integrated research projects aiming at important biomedical problems, collaboration with local industry in biomedical electronics and bioinformatics, as well as multidisciplinary training and education. As a result, research teams have been formed and several integrated program projects are underway. New courses have also been developed and a core lab is also being established to provide students with hands-on training. We look forward to continuing growth and contributions to this exciting field of biotechnology.

貳 新進教師介紹 New Faculty

一、孫啓光 教授 Chi-Kuang Sun, Professor

孫啓光教授之專長為生醫光電。孫教授不到40歲即獲得美國光學學會(OSA)會士之肯定，目前為國內唯一一位獲得美國光學學會、國際光電工程學會(SPIE)、IEEE學會、與英國皇家顯微鏡學會四會會士殊榮之人，在國際上亦不多見。孫教授團隊不但是全國最領先之分子光學影像研究團隊，也是世界上重要光學影像技術，如倍頻式光學顯微術、奈米超音波影像技術、兆赫波乳房攝影術、及兆赫波光纖雷達內視鏡之創始者。孫教授兩次獲得國科會傑出獎及傑出學者研究計畫之肯定，更是國內唯一一位兩度獲得國家衛生院傑出創新研究計畫獎肯定之學者。曾獲Nature Photonics (三次)、Biophotonics International雜誌(兩次)、APS News、the Engineer Online、nanotechweb.org、optics.org、THz Science and Technology Network等專訪報導，其成就更獲選為SPIE BiOS Hot Topics及OSA What is Hot in Optics年度報導中，也是亞洲唯一獲得Leica Microsystem Innovation Award之團隊。孫教授之研究集中於創新研發，其領導之倍頻式光學顯微術不但在解析度與穿透度超越雙光子螢光顯微術兩倍以上，在生物傷害度上更小於雙光子螢光顯微術100倍以上，成為目前臨床活體光學虛擬切片技術中之首選。利用微機電與微光學技術，孫教授團隊更發展出全世界解析度最高、且取像率最高之微型化非線性顯微鏡。在國際旗艦研討會表現上，他也是國內唯一一位在Focus on Microscopy2008會議中發表大會演講者，也是唯一一位受邀在 Photonics West (BiOS)中擔任Plenary及Keynote speaker者。在奈米超音波方面，孫啓光是技術之開創人，並完成全世界首例之二維奈米超音波影像(台灣第一篇發表於Nature Nanotechnology之文章)。他在相關研究之領先地位，使其成為聲學相關領域國際會議之邀請演講常客，更是所有相關會議之委員會成員，也是2010國際聲子會議之大會主席。在兆赫波分子影像方面，孫教授是兆赫波光纖之發明人，相關研究之國際領導者，也是光纖化兆赫波系統之發明人。他完成全世界首例之T-ray mammogram，其靈敏度超越最好之X-ray mammogram 200倍。孫教授是台灣光電學會最高榮譽光學工程獎章最年輕之得獎人，曾任OSA台灣分會主席，目前擔任OSA 會士遴選委員會委員。項專利，此外另有20項微奈米機電及微奈米流體力學專利待核定中，他擔任專書“感測器薄膜及奈米結構：合成、物理及應用 (Functional Thin Films And Nanostructures For Sensors: Synthesis, Physics And Applications)”章節作者，並擔任專書“微流體力學在生物學之應用(Microfluidics for Biological Applications)”主編。他未來的研究方向希望能延續微奈米系統在生醫檢測、醫療技術及生物化學應用之研究。並將微奈米系統與系統晶片相結合，期能在More Than Moore領域做出貢獻。

Chi-Kuang Sun was born in Tainan, Taiwan on January 22, 1965. He received the B. S. degree in Electrical Engineering from National Taiwan University in 1987, and the M. S. and Ph. D. degrees in Applied Physics from Harvard University in 1990 and 1995, respectively. He was a research assistant and a visiting scientist at the Research Laboratory of Electronics, Massachusetts Institute of Technology between 1990 and 1992 and between 1992 and 1994, respectively, working on femtosecond laser development and ultrafast phenomena studies of semiconductor lasers and LT GaAs. He was with the NSF Center of Quantized Electronics Structure (QUEST) at the University of California at Santa Barbara from 1995 to 1996 as an assistant research engineer, conducting research on quantum dots, GaN, microcavity, and high speed communication systems.

Dr. Sun was an associate professor since 1996 and is now a distinghished professor in the Graduate Institute of Photonics and Optoelectronics and Department of Electrical Engineering at National Taiwan University. He is also an adjunt research fellow in the Research Center for Applied Science, Academia Sinica. His research interests are primarily concerned with femtosecond laser technology, ultr-high speed photonics, THz photonics, ultrafast phenomena, novel quantum structures, GaN and related materials, nano-photonics, and biomedical optics.

He has received numerous honors and awards and is a fellow of the Optical Society of America (2004), Royal Microscopical Society (2004) of London, IEEE (2009), and SPIE (2009). He served as the chair of the Taiwan section of Optical Society of America between 2007 and 2008. He received the Outstanding Research Award (2004-2007, 2010-2013) from the National Science Council of Taiwan, Outstanding Researcher Grant Award (2008-2011) of the National Science Council of Taiwan, Merit Award of National Health Research Institute of Taiwan (2003-2009), Research Achievement Award (2004) from National Taiwan University, Academia Sinica Research Award (2001) for Junior Researchers from Academia Sinica of Taiwan, Y.Z. Hsu Scientific Paper Award (2008), Leica Microsystems Innovation Award (2003) from Focus on Microscopy in Italy, and C.N. Yang Outstanding Young Researcher Award (2000) from Association of Asian Pacific Physical Society.

參 研究領域 Research Fields

一、生醫電子組 Biomedical Electronics Group

本組研究主題涵蓋醫學影像、醫療儀器與生醫信號處理、生物晶片與生醫微感測器、生醫光電等數個領域。在醫學影像方面，主要重點是針對核磁共振與超音波造影技術，提升影像的品質、速度與功能性，並發展分子影像技術，應用於臨床醫學診斷、治療以及神經認知科學等方面。在醫療儀器與生醫信號處理方面，重點在開發或利用現有的醫療儀器，擷取各種生理訊號，並且以數位信號處理技術，將有助於疾病的診斷或生理監測的資訊提供給醫療人員。生物晶片的研究重點包括DNA微陣列晶片及之製程、感測技術與資料分析方法，以及以光電蝕刻技術控制生物分子、細胞及微組織之排列，並應用上述晶片進行生物醫學上的研究。在生醫微感測器方面，主要是發展表面電漿共振光學檢測技術與利用標準半導體製程方式，進行生物分子的感測，並進一步將檢測元件微小化。在生醫光電領域，發展高解析度光學顯微影像以及各種光譜技術，提供生物分子、細胞與組織的分析、成像與操控工具，進而輔助疾病的診斷與生醫相關的研究。

Faculty members in this group have diverse research interests including “medical imaging”, “medical instrumentation and biomedical signal processing”, “biochips and biomedical sensors”, and “biomedical optics”. In the area of “medical imaging”, research efforts are focused on magnetic resonance imaging (MRI) and ultrasound imaging techniques. The goals are to improve the quality, acquisition speed and functionality of imaging, as well as to apply these techniques for diagnosis and treatment of disease. In the area of “medical instrumentation and biomedical signal processing”, digital signal processing techniques are used to extract information that is useful for diagnosis or monitoring of physiological status. Research efforts in the area of “biochips and biomedical sensors” are focused on improving the manufacture and detection of DNA and protein microarrays, arranging biomolecules and culture tissue using micro-patterning techniques, development of new data analysis methods for DNA microarrays, and development of miniature biosensors based on surface plasmon resonance (SPR) and nanowire biomolecular sensing devices based on standard CMOS fabrication. The emphasis of research in “biomedical optics” is to use optical microscopy and spectroscopy techniques to detect, image, analyze, and manipulate biological molecules, cells, and tissues. The ultimate goal is to provide information relevant to diagnosis and useful tools for the general biomedical research community.

二、生醫資訊組 Bioinformatics Group

本組研究主題為「生醫資料分析與探勘」、「計算系統生物學」、「計算藥物學及計算化學」以及「醫學資訊系統」。在生醫資料分析與探勘方面，研究重點包括生物晶片(微陣列)資料分析、DNA與蛋白質序列分析、基因及蛋白質結構與功能分析、生醫資料探勘等。在計算系統生物學方面，研究重點則是針對生物醫學及生命科學問題，建構數學分析及模擬計算的系統模型，以作為分析及模擬尖端生物醫學及生命科學現象的基礎。在計算藥物學及計算化學部分，將針對藥物及疫苗開發所涉及的量子化學計算及化學動力學計算建構新的計算模型以及設計更有效率的演算法。在醫學資訊系統方面，研究主題涵蓋層面極廣，舉凡醫學資訊應用所涉及的網路系統、多媒體系統、資料庫系統以及平行計算、分散式計算、即時計算之軟硬體設計與演算法分析均包含在內。

We dedicate our resources on the cutting-edge topics such as "biomedical data analysis and mining", "computational system biology", "computational pharmacology and chemistry". In the area of biomedical data analysis and mining, our major research includes: biochip (Micro-array) data analysis, DNA and protein sequence analysis, gene and protein structure and function analysis, as well as biomedical data mining. In the area of computational system biology, we focused on advanced mathematical system models or simulations we developed to describe behaviors found in biomedicine and life science. In the area of computational pharmacology and chemistry, we are designing new computational models and efficient algorithms in quantum chemistry and molecular dynamics simulation for drugs and vaccine development. In medical informatics, we cover such as a wide range of topics in building the infrastructure for medical informatics, networking, multimedia, database, parallel processing, distributed computing, real-time computing, and algorithms as well as decision making and policy in current national health insurance database.

肆 學術活動 Academic Activities

一、大學跨學門科學人才培育銜接計畫 The Interdisciplinary Training Program for Talented College Students in Science

計劃簡介 Project Description:

本子計畫目標為電機資訊二大學群之整合，為工程背景同學提供跨領域課程，為日後進入生醫資訊、生物科技相關研究之銜接準備。透過本計畫之訓練，學生們於未來可以從事以下相關之前瞻研究：生醫訊號處理、生醫光電、微陣列分析、電腦輔助診斷、生物資訊學、系統生物學以及醫學資訊學等。

為達此目標，並為前二年所開設過的跨領域課程作延伸，本子計畫於99學年度第一學期開設兩門課程：「醫療資訊系統」及「微奈米生物科技專題」，其對象為電資學院之大學部及研究所同學，同時著手撰寫課程教材於課堂使用，作為隨課補充。礙於學期尚未結束之因素，第一年僅提供部分教材作為成果，為求課程教材之完整性與連貫性，本計畫依原規劃，於學期結束後統整學期教材，做為100年度之成果。

本計劃亦將於暑假期間舉行生醫電資營之營隊活動，作為本計畫之輔助。透過課程安排、實驗室參觀及創意競賽之進行，讓不同領域之學員進行交流，養成未來跨領域人才必備之團隊合作能力，引領同學進入跨領域之學習。

The sub-project is a collaboration of teachers in College of Electrical Engineering and Computer Science of National Taiwan University. Through integration, consolidation and participation, we will provide a series of interdisciplinary courses to the engineering students, especially with electrical engineering and computer science backgrounds, to help them get ready to enter research fields such as: computer aided diagnosis, bioinformatics, systems biology and medical informatics.

To continue our previous work during 2008-2009 and achieve the main goal, we offered two advanced courses in 2010: “Medical Information System” and “Special Topics In Micro And Nano Biotechnology.” The courses were offered to the undergraduate and graduate students of the College of Electrical Engineering and Computer Science. At the same time, we developed course materials for class use as supplemental materials. According to the original plan of this project, parts of the materials were provided in the first year as a result, other parts will be finished in 2011.

In addition, we will also organize a summer camp for students to provide them opportunities of learning in an interdisciplinary circumstance. We expect that students can interact with teachers and peers freely through the academic activity.

二、博士班招生說明會
BEBI Introduction to prospective students: College of medicine (2011/03/25)

三、碩士班新生說明會 BEBI Introduction to new students: (2011/04/15)

肆 學術活動 Academic Activities

四、演講 Lectures

1. 99.09.13
   黃齡緹 博士，台南科技大學音樂系
   Topic: 極簡音樂 (Minimal Music)

2. 99.09.20
   張鴻洋 經理，IBM美國華生研究中心
   Topic: On a wellness ecosystem approach of delivering proactive Healthcare services via smart loud computing and smart devices

3. 99.09.27
   陳明豐 院長，國立台灣大學附屬醫院
   Topic: Development of Intelligent Medicine-Perspective of Health Industry

4. 99.10.04
吳文超 教授，台灣大學腫瘤醫學研究所
Topic: Functional Magnetic Resonance Imaging for the Brain

5. 99.10.11
高銘和 老師
Topic: 攀登人升高峰

6. 99.10.18
陳陽成 總經理，恆通高科技股份有限公司
Topic: ：新時代新競爭力

7. 99.10.25
艾琳達 教授，台北醫學大學醫學人文研究所
Topic: 欲蒙其利，卻受其害 — 科技能為人類開創身心健全的未來嗎？

8. 99.11.01
陳一東 教授，德州大學健康科學中心(UTHSCSA)
Topic: Genomic Profiling of atocellularcarcinoma and Hepatoblastoma

9. 99.11.08
王汎森 院士，中央研究院副院長
Topic: 學問與趣味

10. 99.11.22.
孫維仁 教授，臺灣大學醫學院麻醉科
Topic: 臨床醫師在跨領域合作的角色：是瑰寶？還是夢魘？

11. 99.11.29
林孝平 總經理，智原科技顧份有限公司
Topic: 當愛因斯坦碰上蒙娜麗莎－科技與人文

12. 99.12.06
蔡欣穆 教授，台灣大學資訊工程學系
Topic: ：Intra-car Wireless Sensor Networks

13. 99.12.13
陳仲瑄 院士，中央研究院基因體研究中心主任
Topic: Novel Detection Methodology Development with Laser & Mass Spectrometry and Their Applications

14. 99.12.20
周秀芬 副處長，力晶科技公司產品暨行銷研究處
Topic: Applications of Semiconductor Memory in Electronic Devices

15. 99.12.27
侯翠杏 教授，臺灣大學園藝學系
Topic: 談抽象太抽象嗎？

16. 100.01.03
王瑜 教授，台灣大學化學系
Topic: The Journey in Crystallography

17. 100.02.21
吳宗和 技術長，工業技術研究院服務系統科技中心
Topic: R&D Challenges and Opportunities for Personalized eHealth

18. 100.03.07
蘇雅韻 教授，台灣大學資訊工程學系
Topic: Replication-based cyber foraging and automatedsystem management

19. 100.03.14
余明俊 教授，台灣大學生化分生所
Topic: Piecing Out Molecular Puzzles of Renal Water Excretion

20. 100.03.21
譚慶鼎 教授，台灣大學醫學院耳鼻喉科
Topic: 電子病歷

21. 100.03.28
邵耀華 所長，工業研究院生醫與醫材研究所
Topic: 台灣醫療器材規劃與挑戰

22. 100.04.11
周景揚 教授，國家科學委員會副主委
Topic: Future Prospects of IC Design Industry in Taiwan

23. 100.04.18
蔡仁松 教授，國立清華大學
Topic: 從矽谷發展歷史看科技創業

24. 100.04.25
陳朝旺 董事長，泰博科技股份有限公司
Topic: 國際醫療電子產業的趨勢

25. 100.05.02
程海東 校長，東海大學
Topic: 從博雅教育談二十一世紀人才培育

26. 100.05.09
古名伸 教授，國立台北藝術大學 舞蹈學院
Topic: 御風而舞

27. 100.05.16
張進福 政務委員，行政院
Topic: 背負兩年九個月的生技產業計畫

28. 100.05.23
汪大暉 教授，國立交通大學
Topic: Non-Volatile Memory Technology for Tera-Bit Era-3D SONOS Flash Memory

29. 100.05.30
侯維恕 教授，國立台灣大學物理系
Topic: 攻頂之路— 台大高能組的發展

30. 100.06.13
蔡明誠 院長，台灣大學法律學院
Topic: 新科技智慧財產之保護與策略

31. 100.06.09
醫療資訊與ICT轉譯論壇
李嘉哲 醫師，臺大醫院
Topic: 能量醫學 (Energy Medicine)

五、國立臺灣大學電機資訊學院九十九年度畢業典禮
2011 Commencement of College of Electrical Engineering and Computer Science, NTU

六、2011/07/05~07/07生醫電子資訊營
Biomedical Electronics and Bioinformatics Camp on July 5th-7th, 2011

2011臺大生醫電子資訊營於7/5(二)~7/7(四)假臺大博理館舉行，本活動係希望透過系列課程、實驗室參觀及創意競賽活動，介紹如何運用尖端電子資訊技術，協助生命科學基礎研究與改進疾病的診斷與治療品質。今年主題訂為「台灣生醫電資產業之契機」，除邀請電資、醫、工學院講師外，亦多方邀請業界相關人士前來介紹目前生醫電資產業發展現況及未來走向，結合了理論與實務，使學員對跨領域學門有更深一層的認識。

本次活動共62人報名參加，大學生佔51%，研究生佔45%。活動結束後進行學員問卷調查，大部份意見皆認為課程安排及內容豐富、實用，有98%學員認為透過三天的活動可以吸收到生醫領域相關知識及應用，並且培養其跨領域的研究興趣及基礎。同時，學員表達再次參加意願及推薦他人參加的意願高達98%，整體而言頗受好評，給予主辦單位相當大的鼓勵。

Biomedical Electronics and Bioinformatics Summer Camp of 2011, known as BEBI summer camp, was held on July 5th-7th at Barry building in NTU. The main theme of this year was “The prospect of biomedical electronics and bioinformatics industry in Taiwan. “ Based on the course designs, lab tours and innovation contest in the camp, the interdisciplinary knowledge were covered and introduced to the participants. Utilizing these introductory curriculums, participants’ interests for developing biotechnology and bioinformatics can be stimulated and identified.

We had a total of 62 participants with diverse backgrounds; the university student accounts for 51%, and the graduate student accounts for 45%. A 98% satisfaction rate was achieved.

伍 國際交流
International Exchanges

一、2010年遠距健康照護國際研討會
2010 International Telehealthcare Conference

全球慢性疾病普遍與高齡化的社會人口問題，有效整合醫療照護、資通訊技術及電子化醫療器材的跨領域遠距健康照護系統，已成為遠距照護之重要發展趨勢。遠距健康照護服務屬創新型態之新興服務模式，為達到發展創新之科技化照護服務與應用，結合國內資通訊科技優勢，建置因地制宜的遠距健康照護服務模式，並進一步提升國內遠距健康照護之國際視野與經驗，需推展遠距健康照護服務與科技之國際交流。

本次由衛生署主辦，臺大生醫電資所協辦的『2010遠距健康照護國際研討會』以突破、永續、科技化為主題，藉由國際交流來強化國內遠距健康照護服務單位創新思維與服務模式。本研討會特別邀請到跨領域之世界級菁英，包括曾任美國政府醫療諮詢委員會顧問暨於美國遠距醫療領域享有盛名Daniel Riskin醫師，以及美、英、澳共七位國外知名產學專家來台演講，與我國遠距健康照護相關產官學研代表與專家進行經驗交流及討論。因此，本國際研討會以邀請遠距健康照護發展先驅國家，並以技術面、創新服務面、營運面三大面向，提出針對遠距健康照護服務推動策略、營運模式與網絡規劃、電子照護記錄與資訊交換標準國際接軌、創新科技應用及成效評估等，藉由與我國遠距健康照護相關產官學研代表進行經驗交流及討論，以凝聚共識，並經由台灣與國際貴賓齊聚一堂，相互交流實務經驗與執行成果，除增廣彼此之見解外，同時可促進國內遠距健康照護產業發展與國際市場開拓。

二、外賓參訪 International Visits

1. 2011/03/01
   Professor John Cooper, University of Glasgow

2. 2011/05/23
   Dr. Noah Craft MD, PhD, DTM&H
   Topic: Computers and the skin: helping physicians see more clearly

陸 實驗室及教師
Laboratories and Faculty

生醫電子組實驗室 Laboratory of Biomedical Electronic Group

實驗室名稱 Name	主持教授 Advising professor	地點 Room
超大型積體電路系統晶片電腦輔助設計實驗室 SOC VLSI-EDA Lab.	陳中平 Chung-Ping Chen	博理館405 Barry Lam Hall, Room 405
醫學影像實驗室/磁共振影像頻譜實驗室 Medical Imaging Lab./Magnetic Resonance Imaging Lab.	陳志宏 Jyh-Horng Chen	明達館706 MingDa Building, Room 706
智慧型與精密運動控制實驗室 IPMC Lab.	陳永耀 Yung-Yaw Chen	明達館604 MingDa Building, Room 604
放射物理生物實驗室 Radiation Physics and Biology Lab.	成佳憲 Jason Chia-Hsien Cheng	臺大醫院 NTUH
生醫系統與電磁實驗室 Biomedical System and Electromagnetism Lab.	張璞曾 Fok-Ching Chong	明達館702 MingDa Building, Room 702
生物資訊暨生物統計核心實驗室 Bioinformatics and Biostatistics Core Lab.	莊曜宇 Eric Y. Chuang	明達館701 MingDa Building, Room 701
醫用磁振造影實驗室 Magnetic Resonance in Medicine Lab.	鍾孝文 Hsiao-Wen Chung	明達館704 MingDa Building, Room 704
紅外線暨生醫奈米元件實驗室 Infrared and Bio-Chemical Nano-Device Lab.	管傑雄 Chieh-Hsiung Kuan	電機二館426 EE 2, Room 426
細胞行為實驗室 Cell Behavior Lab.	郭柏齡 Po-Ling Kuo	明達館707 MingDa Building, Room 707
生物醫學信號實驗室 Biomedical Signal Lab.	郭德盛 Te-Son Kuo	明達館 705 MingDa Building, Room 705
統計信號處理實驗室 Statistical Signal Processing Lab.	李枝宏 Ju-Hong Lee	電機二館553 EE 2, Room 553
薄膜電晶體實驗室 TFT Lab.	李嗣涔 Si-Chen Lee	電機二館451 EE 2, Room 451
超音波影像實驗室 Ultrasonic Imaging Lab.	李百祺 Pai-Chi Li	明達館731 MingDa Building, Room 731

生醫晶片系統實驗室 Bio-Electronics-System Technology Lab.	林致廷 Chih-Ting Lin	電機二館450 EE 2, Room 450
醫用微感測器暨系統實驗室 Medical Micro Sensor and System Lab.	林啓萬 Chii-Wann Lin	展書樓605/608 Jan Su Hall, Room 605/608
人腦實驗室 Brain Imaging and Modeling Lab.	林發暄 Fa-Hsuan Lin	展書樓703 Jan Su Hall, Room 703
整合神經生理學實驗室 Integrative Neurophysiology Lab.	林則彬 Tzer-Bin Lin	中國醫藥大學附設醫院I棟6樓 China Medical University Hospital
奈米生醫光電實驗室 Nano-Biophotonics Lab.	孫啓光 Chi-Kuang Sun	電機二館R406A EE 2, Room R406A
超快光電實驗室 Ultrafast Optics Lab.	孫啓光 Chi-Kuang Sun	電機二館R407B EE 2, Room R407B
生醫光譜與影像實驗室 Biomedical Optical Spectroscopy and Imaging Lab.	宋孔彬 Kung- Bin Sung	明達館703 MingDa Building, Room 703
微奈米分析技術及系統實驗室 Micro/Nano Analytical Technologies & Systems Lab.	田維誠 Wei-Cheng Tian	明達館509 MingDa Building, Room 509
數位信號處理實驗室 Digital Signal Processing Lab.	曹建和 Jen-Ho Tsao	電機二館552 EE 2, Room 552
心臟輔助器實驗室 Ventricular Assist Device Lab.	王水深 Shoei-Shen Wang	臺大醫院 NTUH
非侵入式生理量測實驗室 Non-Invasive physiological Measurements Lab.	王唯工 Wei-Kung Wang	中央研究院物理研究所 Insitute of Physics, Sinica
臨床磁振影像實驗室 Clinical Magnetic Resonance Imaging Lab.	吳文超 Wen-Chau Wu	明達館 704 MingDa Building, Room 704
	楊泮池 Pan-Chyr Yang	臺大醫院 NTUH

陸 實驗室及教師
Laboratories and Faculty

生醫資訊組實驗室 Laboratory of Bioinformatics Group

實驗室名稱 Name	主持教授 Advising professor	地點 Room
醫學影像處理實驗室 Medical Image Processing Lab.	張瑞峰 Ruey-Feng Chang	資訊館402 CSIE Building, Room 402
演算法與計算生物學實驗室 Algorithms and Computational Biology Lab.	趙坤茂 Kun-Mao Chao	資訊館432 CSIE Building, Room 432
數位相機與電腦視覺實驗室 Digital camera and Computer Vision Lab.	傅楸善 Chiou-Shann Fuh	資訊館328 CSIE Building, Room 328
	黃俊升 Chiun-Sheng Huang	臺大醫院 NTUH
系統生物學研究室 Systems Biology Lab.	阮雪芬 Hsueh-Fen Juan	生命科學館1105 Life Science Building, Room 1105
生物資訊實驗室 Bioinformatics Lab.	高成炎 Cheng-Yan Kao	資訊館401 CSIE Building, Room 401
醫學資訊實驗室 Medical Informatics Lab.	賴飛羆 Fei-pei Lai	資訊館346 CSIE Building, Room 346
演算法實驗室 Algorithmic Research Lab.	呂學一 Hsueh-I Lu	資訊館406 CSIE Building, Room 406
分子生醫資訊實驗室 Molecular Biomedical Informatics Lab.	歐陽彥正 Yen-Jen Oyang	資訊館410 CSIE Building, Room 410
臨床-生物醫學工程-產業融合實驗室 Merger Laboratory for Clinical Sciences, Biomedical Engineering and Industry	孫維仁 We-Zen Sun	臺大醫院 NTUH
生物資訊與化學資訊實驗室 Bioinformatics and Cheminformatics Lab.	曾宇鳳 Y. Jane Tseng	資訊館404 CSIE Building, Room 404

張瑞峰 教授 *Chang, Ruey-Feng ,* Professor

國立臺灣大學生醫電子與資訊學研究所 教授
國立臺灣大學資訊工程學系 教授
國立臺灣大學資訊網路與多媒體研究所 教授

Professor, Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University
Professor, Department of Computer Science and Information Engineering, National Taiwan University
Professor, Graduate Institute of Networking and Multimedia, National Taiwan University

醫學影像處理實驗室
Medical Image Processing Lab.

乳癌是近年來已全球化的婦女死亡的主要原因，如果可以及早查出腫瘤的存在，乳癌治癒的機會將大增不少。在臨床上，電腦輔助診斷系統(CAD)可以幫助醫師分辨惡性和良性的乳房腫瘤，如果電腦輔助診斷系統可以提供更高的準確率，便可以大幅減少乳房切片檢查的需求。從1998年開始，我們致力於發展超音波電腦輔助診斷系統，也有了不錯的研究經驗與成果，成果計有2D/3D超音波、彩色超音波、PC-based超音波、彈性超音波及自動超音波的電腦診斷系統。合作研究單位有美國芝加哥大學，美國U-Systems超音波公司，並與韓國漢城大學醫院、日本獨協大學醫院、台大醫院、台北榮總、中國醫大醫院醫師均有密切合作研究。

In recent years, the breast cancer is globally the main causes of death for women. If a cancer can be found out earlier, the curability of the breast cancer will increase greatly. Clinically, the computer-aided diagnosis (CAD) systems can help physicians to differentiate the benign and malignant tumors. If the computer-aided diagnosis systems have higher accuracy, the demand of the breast biopsy can be reduced. Since 1998, we are devoted to develop the ultrasound (US) CAD systems including 2D/3D US, color Doppler US, color elastography, PC-based US, and automated US. The laboratory also collaborates with The University of Chicago and U-systems Inc., USA. We closely collaborate with physicians from Seoul National University Hospital, Dokkyo Medical University Hospital, National Taiwan University Hospital, Taipei Veterans General Hospital, and China Medical University Hospital.

主要研究領域 Major Research Areas

醫學影像電腦輔助診斷、影像視訊處理、多媒體系統及通訊

Medical Image Computer Aided Diagnosis, Image Processing, Multimedia Systems and Communication

研究計畫 Research Projects

1. 乳房彩色彈性超音波之電腦輔助診斷
   Computer-aided Diagnosis System for Breast Color Elastography
2. 自動乳房超音波之電腦輔助診斷
   Computer-aided Diagnosis System for Automated Breast Ultrasound

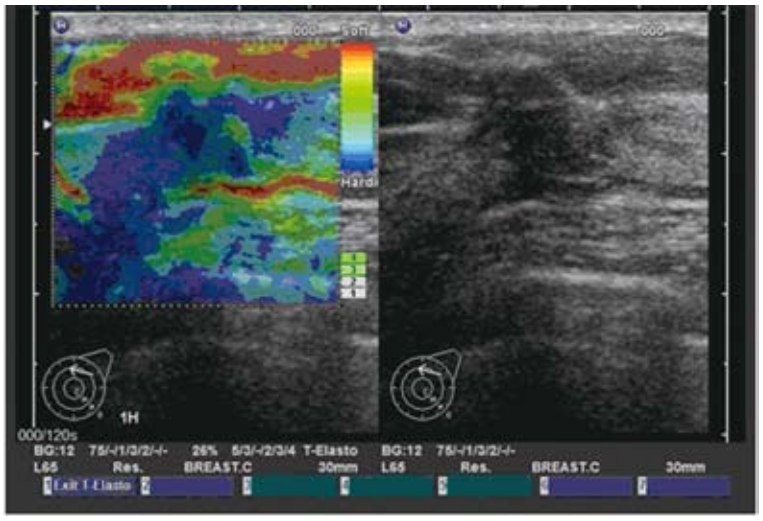
計畫名稱：乳房彩色彈性超音波之電腦輔助診斷
補助單位：行政院國家科學委員會
計畫期間：2009/08/01 – 2012/07/31

彈性超音波是繼彩色Doppler 超音波之後最重要的超音波新技術，彈性超音波影像是利用超音波探頭對組織輕微施加壓力，組織會因壓力的關係而產生位移，而組織的位移可利用比對鄰近的超音波射頻訊號的方式得知，再經由組織的位移即可評估組織的彈性。組織的彈性會因年齡、發炎、或有腫瘤存在而改變組織的彈性，一般而言，良性腫瘤會比較軟而惡性腫瘤會比較硬，因此利用施壓測量組織的彈性對於腫瘤的診斷是已証明是不錯的診斷方法。早期的彈性影像是以灰階的形式呈現的，而彩色彈性超音波是將灰階的彈性影像轉成半透明、彩色的彈性影像疊在傳統B-mode影像上，如此更可增加彈性影像可讀性，更容易判斷腫瘤內、外組織的彈性特性。本計畫將針對彩色彈性超音波發展電腦輔助診斷系統，第一年將由彩色彈性超音波還原出彈性資訊，再利用腫瘤部分的軟硬程度發展可靠的診斷特徵。第二年將同時利用彈性影像及傳統B-mode灰階影像來診斷腫瘤，除了將比較彈性診斷特徵及B-mode診斷特徵，也將結合二種特徵以提高診斷準確度。第三年將加入自動腫瘤切割以完成全自動的診斷系統，同時也將分析彩色彈性超音波連續動畫影像，以減少操作者不同壓力對診斷的影響。

Project title: Computer-aided Diagnosis System for Breast Color Elastography
Supported by: National Science Council
Project period: 2009/08/01 – 2012/07/31

The elastography is the most important development in ultrasound technology since the advent of Doppler imaging. The principal of elastography is that tissue compression produces strain within the tissue and that the strain is smaller in harder tissue than in softer tissue. Therefore, by measuring the tissue strain induced by compression, we can estimate tissue hardness, which may be useful in diagnosing breast cancer. In the color elastographic images, strain data are converted into a color scale imaging that is superimposed on B-mode imaging. Colors range from red, corresponding to soft tissue, to blue, the stiff one. In this project, color breast elastography is adopted to analyze breast tumor. In the first year, the original strain information will be recovered from the color elastography by computing the hue information. The strain information will be used in the proposed computer aided diagnosis system. In the second year, both elastography features and B-mode features are used to classify breast lesions in breast images. Moreover, these two types of features will be compared to check whether the strain information is more useful than B-mode information for diagnosis and whether the strain information could improve the diagnosis or not. In the third year, an automatic tumor segmentation method based on the fuzzy method will be developed in order to complete a fully automatic computer aided system for color breast elastography. Also, the continuous elastographic images will be analyzed to insure the reproducibly and reliability of the color elastography.

代表圖及中英文說明：



Color elastography
彩色彈性超音波

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演算法與計算生物學實驗室
Algorithms and Computational Biology Lab.

演算法與計算生物學實驗室創立於2002年8月。我們的研究主軸為「序列」與「樹狀結構」主題相關的演算法設計，以及利用這些演算法為基礎的生物資訊軟體工具開發，可說是「計算理論為體，生物資訊為用」。在過去幾年裡，我們的研究主軸是關於序列及樹狀結構上的有效演算法設計與分析。在序列方面，包括生物序列分析，如：單套體預測問題、標記SNP、複製數目變異問題、各種不同評分準則等，以及數列分析，如：最大總和區段問題、最大平均區段問題、不同條件的最佳化問題等。在樹狀結構方面，包括樹的建構問題，如：演化樹建構、最小繞線代價伸張樹問題等，以及樹的探索問題，如：樹邊分割問題、樹的查詢問題、樹邊置換問題等。這是非常有樂趣及成果的研究歷程，我們最終的目標是開發更多關於序列及樹狀結構的基本性質，並充分運用它們來設計解決這方面計算難題的實用演算法。

The Algorithms and Computational Biology Laboratory was established in August, 2002. We are interested in all aspects of the design and analysis of combinatorial algorithms. In particular, we solve algorithmic problems arising in computational molecular biology and networking. For the past few years, we have been mostly focused on the design and analysis of efficient algorithms for analyzing sequences and trees. For sequences, we mainly work on problems related to biological sequence analysis (haplotype vs. genotype; tag SNPs; copy number variations; variant scoring schemes), and numerical sequence analysis (maximum-sum segments; maximum-average segments; other maximization criteria). For trees, we mainly work on some tree construction problems (evolutionary trees; minimum routing cost spanning trees), and tree exploring problems (tree edge partition; tree querying; swap edges). This has been a joyful and fruitful journey to us. Our ultimate goal is to reveal more properties related to sequences and trees, and fully utilize them to design practical algorithms for solving hard problems in that line of investigation.

主要研究領域 Major Research Areas

計算生物學及生物資訊學、演算法、套裝軟體
Computational Biology and Bioinformatics, Algorithms, Software Tools

研究計畫 Research Projects

1. 單一核苷酸多型性資訊運用的演算法設計
   Efficient Algorithms for Utilizing SNP information
2. 線上拓撲排序問題之快速演算法
   Fast Algorithms for Online Topological Ordering
3. 多重基因複製問題的快速演算法
   Faster Algorithms for the Multiple Gene Duplication Problems

計畫名稱：多重基因複製問題的快速演算法
補助單位：行政院國家科學委員會
計畫期間：2009/08/01-2012/07/31

在演化分子生物學裡，種系發展分析可協助理解不同生物間的演化關係。一棵種族樹可以用來代表一個種族集合之親緣關係；一棵基因樹則描繪出一群種族就某個基因家族所建立之親緣關係。由於複雜的演化過程，如：基因複製、水平基因轉移、染色體重組等，基因樹和種族樹之間可能產生不一致的地方，演化生物學家必須能進一步解釋這些不一致的地方。

前人以對應基因樹與種族樹的調和模式，來解釋這些不一致產生的原因。這方面有個重要的問題稱為「多重基因複製問題」，它將基因複製事件，從基因樹對應到種族樹。本計劃將探討多重基因複製問題上的兩個主題：一個主題稱為「事件叢集問題」，該問題要在種族樹上找出最少的地方，來放置所有應該產生的複製事件；另一個主題稱為「最少事件問題」，該問題要在種族樹上決定發生複製事件的樹點，使得複製事件的總數為最少。

我們將設計解決「事件叢集問題」的更快速解法，這問題已被證明是「樹區間覆蓋問題」的特例，透過調整整個樹的拜訪順序，我們希望能設計出這兩個問題的最佳解法。我們也將設計解決「最少事件問題」的更快速解法，主要是要加速下面四個步驟：(1) 計算最低共同祖先對應關係；(2) 找出所有帶頭的樹點；(3) 檢查帶頭樹點是否自由；(4) 修訂對應關係。我們進一步檢驗基因叢集裡的資料，從而建立一套更合適的模組，希望能有統一的理論可處理各式各樣的演化事件，如此得到的重建過程將更貼近實務需求。

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Project title: Faster Algorithms for the Multiple Gene Duplication Problemsn
Supported by: National Science Council
Project period: 2009/08/01-2012/07/31

In the evolutionary molecular biology, phylogenetic analyses help to realize the evolutionary relationship among various organisms. A species tree represents the phylogeny of a set of species, and a gene tree depicts the phylogeny among a gene family for a set of species. Due to complicated evolutionary processes such as gene duplication, horizontal gene transfer, recombination, etc., gene trees and species trees may be inconsistent. It is important for evolutionary biologists to explain the inconsistency between gene trees and species trees.

The reconciled tree provides the mapping between genes trees and a species tree that explains the inconsistency in the evolutionary history. The Multiple Gene Duplication (MGD) problem is to map gene duplications from the gene trees into the species tree and to cluster such mapped duplications into a few genome duplications. In this project, we study two variants of the MGD problems with different cost function measurements. Given are a set of gene trees and a species tree. The first problem, called the Episode-Clustering problem, is to find a minimum number of locations in the species tree for placing all duplications in the gene trees. The other problem, called the Minimum Episodes problem, is to assign duplication events to nodes in a species tree such that the total number of episodes is minimized.

We will design faster algorithms for the Episode-Clustering problem, which has been shown to be a special case of the Tree Interval Cover problem. By traversing the tree in an appropriate order, we wish to design an optimal algorithm for both problems. We will also design faster algorithms for the Minimum Episodes problem. We need to speed up the following four steps: (1) computing the LCA-mapping, (2) finding all leading nodes, (3) checking if these leading nodes are free, and (4) updating the mapping. We will examine the data in the gene clusters more closely and establish a more robust model for them. We will set up a unified theory for handling all evolutionary operations in order to make the reconstruction work in practice.

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Professor, Graduate Institute of Biomedical Electronics and Bioinformatics/ Department of Electrical Engineering, National Taiwan University

超大型積體電路系統晶片電腦輔助設計實驗室
SOC VLSI-EDA Lab.

自2003年成立至今,本實驗室一向是一個不斷追求創新及擴展知識的一個的國際化研究團隊,其研究領域包括了生醫電子,電腦輔助設計及數位IC設計實驗室，其研究重點在於針對電路實體設計及時序之最佳化以及線路模擬，及在針對製造時所產生之製程移之影響及解決方案。最近，我們又極力發展生醫MRI及PEI影像及血管模擬以及半導體光學製程之模擬之最佳化。在IC設計方面，我們主力在發展在高速低功率之微處理機所須之電路。本實驗室目前的研究方向主要可分為五大領域

- 生醫MRI、PET影像處理
- 可製造性設計
- 生醫行動生理檢測系統
- 數位電路之最佳化
- 統計型時序分析
- 高效能電路設計
- 半導體學製程影像之模擬與處理

Established in 2003, BIO-EDA-VLSI Lab has been relentlessly pursuing new challenges and enrich knowledge in the field of EDA, VLSI circuit design, and BIO/Optical Microlithography Image Simulation and Processing. The focus of our research field include the following 5 major projects:

- Biomedical MRI,PET Imaging processing
- Digital Circuit Optimization
- Design for Manufacturabiliy
- Statistical Static Timing Analysis
- High Performance Circuit Design
- BIO and Optical Microlithography Imaging Simulation and Processing

主要研究領域 Major Research Areas

生醫及半導體光學製程影像處理、微處理機設計、VLSI電腦輔助設計、微波通訊線路設計
BIO/Optical Microlithography Image Processing, VLSI CAD, Microprocessor Design, RF Mix/Signal Circuit Design

研究計畫 Research Projects

1. 次微米下之高速電路及低耗電最佳化
   Deep-Sub-Micron High-speed Low Power Optimization
2. 動態邏輯加法器設計及自動化
   Domino Adder Design and Automa
3. 次微米級干涉週期量測之診斷演算法
   Efficient and Accurate Optical Scatterometry Diagnosis of Grating Variation Based on Segmented Moment Matching and Singular Value Decomposition Method

計畫名稱：行動式無線癲癇症預測雲端系統
補助單位：台大醫院
計畫期間：2011/08/01 – 2012/07/31

在歐美癲癇症的患病率高達0.52%及0.68%，台灣約有14萬人罹患不同程度的癲癇,而其中約15-30%的病患對藥物治療反應不佳，而癲癇症發作時病人往往失去知覺，因此若能有效預測並及時施予救治,即能有效預防癲癇症解救危機,然而癲癇症發作的時間地點經常無法預測，因此行動癲癇症預警系統有相當的重要性。近年來迷走神經刺激法(VNS, Vagus nerve stimulation therapy) 已成功的發展及運用,且目前已有3萬人使用,但正確精準的時機去啓動VNS還是一項重要的課題。

我們第一年目標將建立Multi-channel的行動癲癇症預警系統，第二年將著手建立植入性電極系統發展並且驗證大量台大臨床資料。而腦電圖為監控癲癇症之發作以及癲癇預測最重要的指標。一般神經內科醫師判斷癲癇症發作的條件為：一、突然出現和背景腦電波不一致的腦電波組合。二、腦電波的頻率劇烈轉變成特定模式。三、在平時的腦電波中出現了癲癇樣棘波。四、腦波的異常能量上升。五、上述之棘波重複出現的腦波由單一頻道擴散到鄰近的頻道中。

利用上述判斷資法則及運用我們新開發的EEG 判讀科技，我們將延續與台大神經內科邱銘章醫師合作開發偵測癲癇症的系統。利用Portable EEG Instrument 與Android手機結合,將腦波機所量出來的腦波無線傳輸至手機，再利用本團隊所研發的演算法，快速做到Alarm的效果，以防止病人癲癇發作並即時傳至雲端主機分析，即時醫治,並降低醫療成本。若開發成功，預計將成為下一步VNS整合系統之基礎架構。

Project title: Mobile Wireless Epilepsy Seizure Prediction System with Cloud Computation Method
Supported by: NTUH
Project period: 2011/08/01 – 2012/07/31

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醫學影像實驗室
Medical Imaging Lab.

醫學影像實驗室目前位於臺灣大學明達館七樓 (room706)。負責人為陳志宏(Jyh-Horng Chen)教授，助理一人，研究生六人，博士班學生一人。主要研究方向為核磁共振造影(MRI)、殘障者人機介面與噪音抑制(Noise cancelation)等研究主題。在電機一館一樓設有MRI/MRS實驗室，設有一台Bruker 3.0 Tesla MR，平時提供校園內學術單位做研究，以及本實驗室研究造影技術之用。

核磁共振影像頻譜實驗室
Magnetic Resonance Imaging Lab.

本實驗室於1999年成立，以提供有效、可靠的成像技術及訓練課程予各研究領域之研究學者，心理學家、生理學家、動物學家，可藉由磁振光譜影像之重建方式，為未來之基因蛋白體研究、動物病變模型之評估，提供微細且精確的訊息，以成為台灣的MRI研究及人才培訓資源中心。另一方面，本實驗室亦從事新技術之研發，期能突破現有磁振造影 (MRI) 之成像速度限制，提升磁共振影幅系統成像能力及台灣在磁共振領域之國際知名度，並藉由國內現有MR研究資源合作，以跨學科之研究，使人文、科學、醫學、工程等不同學科得以匯整激盪，並創造21世紀之新學門科學，建立一個世界級之核磁共振卓越中心。主要研究方向包括：大腦功能性磁振造影、擴散磁振造影、MR線圈設計、MRI成像最佳化技術、超快速平行擷取MRI系統、小動物生理病理研究、分子影像。

The laboratory will apply the existing MRI / MRS techniques to interdisplinary research, including school of humanity, psychology, medicine, engineering, agriculture and food science. Its object is to combine experts in different areas to generate, hopefully, some new academic areas in 21 century. This laboratory is supported by National Taiwan University (NTU) as well as Instrumentation Center of National Science Council (NSC) in Taiwan.

生醫分子影像核心實驗室
Biomedical Molecular Imaging Core Lab.

此核心實驗室結合磁共振(MR)分子影像 、光學分子影像 (Optical molecular imaging) 及超音波分子影像 (Ultarsonic molecular imaging)，此外，為使活體中特定的分子成像，除了要有上述高分辨率、敏感、快速的成像技術，還具備合成具有高親和力的分子探針及具有特異標定之顯影劑。

本核心實驗室主要目標之一為提供分子醫學影像之量測與生物體之醫學成像技術研究服務予台灣大學醫學院區內從事生物醫學、基礎醫學與臨床醫學研究人員，此外，本實驗室致力發展新型醫學影像之顯影劑開發，並結合分子生物之技術，開發新式具特異標定功能之奈米粒子。

This core combined MR molecular imaging, optical molecular imaging and ultrasonic molecular imaging, thence, besides above mentioned properties, high spatial resolution, sensitivity and fast imaging technology, it has the ability to synthesize high affinity molecular probe and specific-targeting contrast agent, and then in vivo specific molecular imaging will be obtained.

Our primary aim for this Biomedical molecular imaging Core is to provide research services to all the investigators within NTU medical campus, and conducting methodological research related to biomedical molecular imaging is our secondary aim. On other hand, we also develop the novel contrast agents which have specific targeting function for disease model.

主要研究領域 Major Research Areas

核磁共振影像、醫學工程

Magnetic Resonance Image, Functional MRI, Molecular imaging, Man Machine interface, Medical Engineering

1. 心智科學大型研究設備建置及共同使用服務計畫—大腦與心智文化整合性研究
   Installation and Operation of Core Facility in Mind Science: An Initiative for Integrated Research on Brain, Mind and Culture
2. 供癌細胞/幹細胞血統追蹤之基因改造鼠：研發及應用--具標定功能奈米顯影劑及複合式生醫分子影像技術平台之研究：以雙螢光基因及白喉毒素受體基因替換小鼠為模型（子計畫二）
   Genetically-Gngineered Mice for Cancer Cell / Stem Cell Lineage Tracing : Research and Application
3. 發展動態磁振造影及具標定之生醫分子影像：評估肺癌與轉移肺癌小鼠模式之治療反應－發展動態磁振造影及具標定之生醫分子影像：評估肺癌與轉移肺癌小鼠模式之治療反應
   Evaluating Therapeutic Response of Lung Cancer and Metastatic Lung Cancer in Mouse Models with DCE MRI and Targeted Molecular Imaging
4. 大腦如何調節自發性節律平靜狀態下腦功能性連結之探討與應用
   How Does Brain Coordinate Spontaneous Fluctuation?
5. 影像導向神經幹細胞之應用於中風及週邊神經創傷－神經幹細胞之非侵入式磁振影像追蹤（子計畫三）
6. 基因體醫學研究中心
   Program for Excellence Research Teams：NTU Center for Genomic Medicine -Biomedical Molecular Imaging Core Lab

計畫名稱：心智科學大型研究設備建置及共同使用服務計畫—大腦與心智文化整合性研究
Installation and Operation of Core Facility in Mind Science: An Initiative for Integrated Research on Brain, Mind and Culture
補助單位：行政院國家科學委員會
計畫期間：2010/08/01-2013/07/31

MRI及MEG作為研究工具是一重要趨勢，但目前人文社會科學學者使用此兩項儀器從事研究者並不多。國科會人文處既已投注經費建置，帶動研究者來使用，是執行機構的責任，因此人才培訓的工作就很重要。要如何讓潛在人才浮現、如何讓人文社會科學各領域（如社會行為、經濟行為、道德行為、藝術、精神醫學、法律、教育等等）研究已經做得不錯的學者能嘗試使用這些設備來提升其研究，則未見有詳細規劃。

計畫名稱：發展動態磁振造影及具標定之生醫分子影像：評估肺癌與轉移肺癌小鼠模式之治療反應－發展動態磁振造影及具標定之生醫分子影像：評估肺癌與轉移肺癌小鼠模式之治療反應
Evaluating Therapeutic Response of Lung Cancer and Metastatic Lung Cancer in Mouse Models with DCE MRI and Targeted Molecular Imaging
補助單位：行政院國家科學委員會
計畫期間：2009/08/01~2012/07/31

本研究計畫將利用兩種肺癌轉移的動物模式作為研究標的：其一為受放射線治療誘發肺癌轉移的動物模式(C57BL/6品系)，其腫瘤細胞為Lewis lung carcinoma(LLC-LM)；其二為SCID之動物模式，其腫瘤細胞為CL1-0、CL1-5、與Mock 189來探討腫瘤轉移形成機轉。在針對細胞分子表現特異性鑑別之奈米顯影劑的發展平台部份，可藉由測試修改奈米表面以改良並同時具有正子斷層掃瞄與磁振造影之對比顯影的效果。藉由發展新型態之奈米粒子作為吸收近紅外光誘發熱治療之雙效奈米藥物。根據過去的文獻報導，為新生血管之表面受器，其可被RGD-4C特異標定其腫瘤新生血管。而同時EFGR(Epidermal growth factor receptor)為一腫瘤生長激素表面受器，其功能可被抗EGFR抗體抑制，因此未來將進一步連結抗腫瘤及新生血管特異性表面抗原分子，如EGFR及RGD-4C，以作為融合標的投遞之導向器及攻擊武器於一體之多功製劑。

在磁振造影之分子影像擷取部份，此計畫將整合跨領域的磁振造影技術，包括擴散磁振造影、微灌流磁振造影、顯微磁振造影以建立一個宏觀且領先的磁振分子影像造影技術。此外，本團隊將發展出高效率改良式的高速成像序列及高溫超導射頻線圈造影技術並使用具有強梯度磁場的顯微造影線圈及平行影像技術及其重建演算法，藉以大幅提升影像敏感度、解析度、訊雜比、及取像速度。為了適用於活體動物實驗，本計畫將結合上述改良造影技術於3T (Tesla)以及7T 磁振造影系統並結合動物正子斷層掃瞄以建立小鼠實驗影像技術整合平台。有了此一最佳化之小動物平台，將有助於研究奈米顆粒顯影劑的對比特性、建立適合於磁振照影對比強化的肺癌動物模型之造影平台、並評估動態顯影之核磁共振照影技術與合成之奈米顆粒顯影劑之體內生物分佈及標記之功效。

本研究整合一流之生醫及理工研究團隊以從事動態顯影、奈米顯影粒子、顯微磁振造影、及動物正子斷層掃瞄等結合上中下游之整合研究建立活體動態追蹤動物腫瘤治療評估及轉移過程的分子影像模式，分析放射線引發肺癌肺臟轉移過程中血管新生與缺氧誘發因子的動態表現情況，以釐清血管新生與缺氧誘發因子對應其標靶藥物在抑制小鼠腫瘤肺部轉移治療之應用潛力，以期密切的交流互動及研究成果達成預期研究目標，提升在國際上的能見度，達到生醫分子磁振造影技術之領先地位。

計畫名稱：供癌細胞/幹細胞血統追蹤之基因改造鼠：研發及應用--具標定功能奈米顯影劑及複合式生醫分子影像技術平台之研究：以雙螢光基因及白喉毒素受體基因替換小鼠為模型(子計畫二)
Genetically-Gngineered Mice for Cancer Cell / Stem Cell Lineage Tracing：Research and Application
補助單位：行政院國家科學委員會
計畫期間：2009/08/01~2012/07/31

本研究計畫是整合光學及磁振造影之生醫分子影像技術平台針對基因剔除/嵌入之動物模型進行細胞與生物體內之組織特異幹細胞 (tissue specific stem cells)與腫瘤幹細胞 (cancer stem cells) 的影像追蹤，以瞭解細胞分化與腫瘤生成的過程。此外並發展具白喉毒素受體標定之奈米顯影劑以增進磁振造影之靈敏度

與偵測極限。此外，藉由微光學內視鏡系統與動物磁振造影平台的整合，達到磁振造影導引光學探針之技術發展。

本研究重要的議題，可分成兩項：其一藉由本研究計畫的執行，可發展肝臟再生動物模式之醫學影像偵測平台，並對於肝癌化之動物模式及肝臟前驅細胞進行活體內之動態影像觀測，利用生醫分子影像系統與組織切片之比對，瞭解肝臟再生、肝癌化過程、及肝臟前驅細胞之基因調控的研究；其二針對腦部發育及幹細胞分化的過程結合Diffusion Tensor MRI與功能性磁振造影技術平台，瞭解神經幹細胞之分化、發育、遷徙得過程。

計畫名稱：大腦如何調節自發性節律 平靜狀態下腦功能性連結之探討與應用
How Does Brain Coordinate Spontaneous Fluctuation?
補助單位：行政院國家科學委員會
計畫期間：2008/12/01~2011/11/31

本計畫的最後一個目標是建構一個屬於台灣華人之大腦功能連結資料庫系統，這個資料庫包含一般無心理疾病病史之普通人與精神分裂症患者。藉由先前所指出之欲發展架構之技術與敝實驗室早先開發之台灣華人大腦結構影像圖譜，我們將可以針對更細微的功能與結構變化相比對，以其在大腦功能連結上得到更具意義之發現。同時，在不同階段的發展情況下之大腦功能連結資訊，將對於人類大腦功能發展是如何由混沌到井然有序的過程，將會有莫大之助益。因此，對於發展一個可用於臨床診斷上的標準模板，發展與建構第一個台灣華人之資料庫將扮演一個關鍵之角色。

總括來說，發展與建構上述所言之技術，將對大腦科學研究有莫大助益。第一，對於平靜態大腦功能性連結將有更進一步的生理意義之探討。第二，發展與建構大腦功能連結之取像與分析技術。第三，建構台灣華人之資料庫系統中心，提供臨床診斷與大腦科學研究之標準與參考依歸。這份研究將會把平靜 態大腦功能連結技術發展為新世代的診斷工具，並且擴展其應用層面，增進我國大腦科學研究於國際上之競爭力。

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智慧型及精密運動控制實驗室 IPMC Lab.

本實驗室「智慧型精密運動控制實驗室」由陳永耀教授領導，位於明達館604室，其研究的主要方向為智慧型控制與超音波熱療。實驗室的近期研究領域分成反向光學微影技術、電子束微影系統、姿態辨識聲音的分析與處理、仿生機械人、及超音波熱療等五大主題。

反向光學微影技術的研究是針對在IC製程上小尺度的光罩所產生的繞射現象，在光罩設計時將繞射現象考慮進去，設計出最佳的光罩形狀。電子束微影系統的研究是在IC製程中的電子束蝕刻時，對電子束做位置的訊號回授控制以修正電子移動時所產生的漂移現象。姿態辨識的研究是利用人工智慧的方式來處理影像中的資訊，本實驗室建立影像的監視系統應用在老人看護上。另外在聲音處理的方面是利用訊號處理的方式將聲音中的雜訊濾除，進而研究聲音本質與語者分析。仿生機械人的研究是模仿生物的運動模式，將生物的優點轉換成電機領域的應用，近期的研究是將蛇的運動設計成新型的載具。超音波熱療的研究是發展新的預測方式，來追蹤人體中因呼吸而上下運動的腫瘤細胞，使得聚焦的超音波能夠正確的加熱在腫瘤細胞上，殺死腫瘤細胞。

本實驗室致力於將智慧型控制嘗試應用在各方領域，將機械自動化，改良儀器控制法，改善人類生活。

Intelligent Precision Motion Control Laboratory is lead by Prof. Yung-Yaw Chan and located in room 604, Minda building. Researches included inverse optical micro-lithography, electron beam lithography, motion identification, sound Analysis, biomimetics, and high intensity focus ultrasound.

Inverse optical micro-lithography is to design the optimal from of the mask, due to the diffraction of light changes. Electron Beam Lithography is to write on wafers by electron beam directly. We use sensors to feedback control the system to reduce beam broadening and proximity effect. In motion identify, we analyze the human activities for the home care systems. Biomimetics is to study the biological structure and the locomotion of real snakes, and to develop and design advanced platform actuation systems. Our laboratory applies Intelligent Control to automate machine and to improve the system performance.

主要研究領域 Major Research Areas

智慧型控制、居家看護、精密伺服控制、超音波加熱治療

Intelligent control, Home care, Precision servo control, Hyperthermia treatment planning

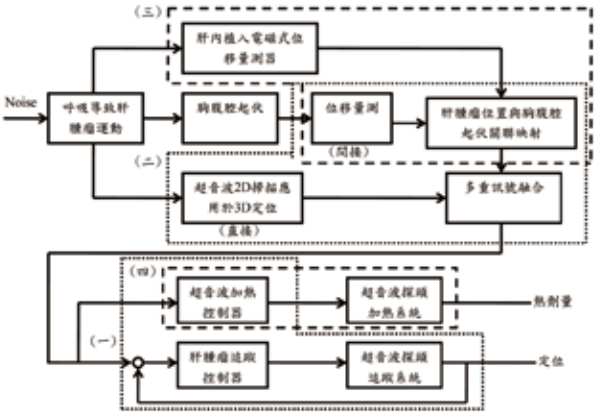
研究計畫 Research Projects

1. 由呼吸導致週期性位移肝腫瘤之超音波熱劑量控制方法研發(總計畫)
   Development on High Intensity Focused Ultrasound Thermal Therapy Tracking Control on Liver Tumor with Respiration-induced Periodic Motion
2. 肝腫瘤位置追蹤及高強度聚焦超音波熱療控制系統研發(子計一)
   Development on Liver Tumor Tracking and High Intensity Focused Ultrasound Thermal Therapy Control System
3. 以影像為基礎之多目標智慧型動作辨識
   Vision-based Multi-target Intelligent Human Motion Identification
4. 智慧型居家看護影像監控系統 (II)
   Intelligent video surveillance on home care system(II)
5. 應用於熱手術與熱治療之高強度聚焦超音波患能器開發(I)
   Effects of HIFU cavitation and nonlinearity on the thermal lesion formation and its applications for thermal therapy
6. 蛇形仿生運動機制及前瞻載具驅動系統之研究-總計畫：蛇形仿生運動機制及前瞻載具驅動系統之研究
   Biomimetic snake locomotion and its application to advanced platform actuation systems—master plan
7. 蛇形仿生運動機制及前瞻載具驅動系統研究-子計畫四：蛇形運動控制方法及前瞻載具驅動器設計
   Biomimetic snake locomotion and its application to advanced platform actuation systems—sub plan
8. 智慧型居家看護影像監控系統(III)
   Intelligent video surveillance on home care system(III)

9. 座艙聲紋分析系統之研發
   Development of voiceprint analytical systems for cockpit voice recorders
10. 高強度聚焦超音波穴蝕化與非線性對熱治療區形成之影響及其在熱治療應用之研究(II)
   Investigation of high intensity focused ultrasound for moving tumor thermal therapy
11. 高強度聚焦超音波應用於運動中腫瘤之熱治療探討
   The beating effect of confocal ultrasound on the thermal lesion formation
12. 共焦聚集超音波熱治療時聲拍作用對熱燒灼區形成之影響
   Development of HIFU transducer for thermal therapy and surgery
13. 以影像為基礎之智慧型動作辨識
   Vision-based Multi-target Intelligent Human Motion Identification

計畫名稱：由呼吸導致週期性位移肝腫瘤之超音波熱劑量控制方法研發（總計畫）
補助單位：行政院國家科學委員會
計畫期間：2009/08/01-2011/07/31

惡性腫瘤高居台灣十大死因之首，而有效的治療方式中，超音波加熱治療較外科手術切除、放射線療法、栓塞法與化學療法等方法有更低的副作用及非侵入性，而為極有潛力之腫瘤治療方法。以高強度聚焦超音波進行治療時，必須準確地聚焦在所要治療的患部，以避免在正常的組織形成過多的熱劑量分布。動態腫瘤如肺癌、肝癌，由於呼吸及橫膈膜的影響產生週期性的往復運動。為了能夠準確的定位運動中的肝腫瘤，並施以適當的加熱治療，本計畫將依量測、控制、探頭、及生理等多領域進行研究。在子計畫二主要研究的量測方面，將分為間接量測與直接量測。由於肝臟位於人體腹腔內，現有之掃描技術雖然可以取得非常精細之圖像，但速度遠低於即時控制所需。因此計畫將同時推動以量測胸腹腔起伏關聯至肝臟運動之間接量測方法與分析，進行多重感測訊號融合，以及以二維超音波掃描轉換為三維定位資訊之量測技術。在子計畫三之生理實驗相關研究上，將以活體實驗方式量測肝臟位置，以進行間接量測之關聯性分析，同時多方面探討各項生理參數與限制條件對肝臟位置關聯性之影響。此外子計畫三最後將進行超音波熱療之活體實驗，確認計畫執行成效。在子計畫四主要研究之探頭設計方面，將發展順型(conforming)加熱之探頭設計，以期能夠在最短時間內達成有效之加熱療效，並阻抗控制觀念下進行探頭理論之開發。子計畫一之主要任務在完成高強度超音波熱療之肝腫瘤追蹤控制系統設計與建構，除了系統整合與協調各子計畫研究工作進行外，預計探討即時之智慧型重複控制方法(Intelligent Repetitive Control)，以及以較慢之三維定位資訊進行即時控制系統之週期性校正。



圖一 子計畫關聯性之控制方塊圖

整體而言，本計畫結合國立臺灣大學電機／生醫電資、機械、醫學各系所之傑出研究團隊，研發因呼吸導致週期性運動之肝腫瘤高強度聚焦超音波追蹤控制熱療系統，有效整合各領域專長，提升國內醫療設備開發能力，並將以活體實驗確實驗證計畫成果。

Project Title: Development on High Intensity Focused Ultrasound Thermal Therapy Tracking Control on Liver Tumor with Respiration-induced Periodic Motion

Supported by: National Science Council
Project Period: 2009/08/01-2011/07/31

Cancer has been the top cause of death for people in Taiwan for many years. Among its possible treatments, such as surgery, radiation, blocking, and chemical therapies, the High Intensity Focused Ultrasound (HIFU) thermal therapy is regarded as one with great potential due to its low side-effect and noninvasiveness. With HIFU, the target area has to be quite accurate to avoid the possible damage of normal tissues from the excessive thermal distributions. Some of the tumors, such as liver or lung cancers, will have periodic motions from the respirations. Our project is focused on the sensing, heating, in vitro experiment, control and system integration so that an effective thermal therapy methodology can be achieved. In project II, indirect sensing of liver motion through the chest and abdomen motion will be conducted and studied. Also from the fact that current imaging technology is not fast enough for real-time control, a technology by utilizing the 2D ultrasound images and transform to the 3D liver position will be developed. Project III will conduct in vitro experiments for liver motion data acquisition and analysis. And will also investigate the relationship between possible factors with the liver tumor position. At the final stage, project III will conduct an in vitro experiment with integration of the sensing, heating, and control of all the other projects for verifications. Project IV will study the conforming transducer design with the concept of impedance control and optimal heating strategies. Finally, project I will be mainly on the tracking control system design. Intelligent repetitive control will be studied to combine the repetitive control theory and the neural networks to form a real-time control system with periodic updating mechanism. Project I will also be responsible for system integrations.

Overall, an excellent research team is integrated with members from the NTU EE/BMEI, ME, and Medical departments to make joint efforts on this project. This project is expected to have excellent results academically and promote the domestic research capability of medical therapy equipments.

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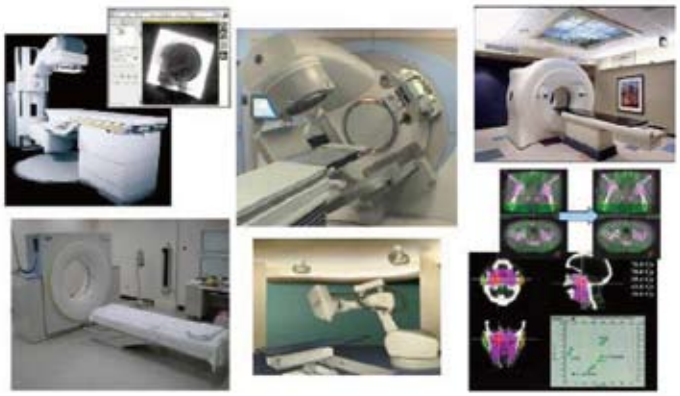
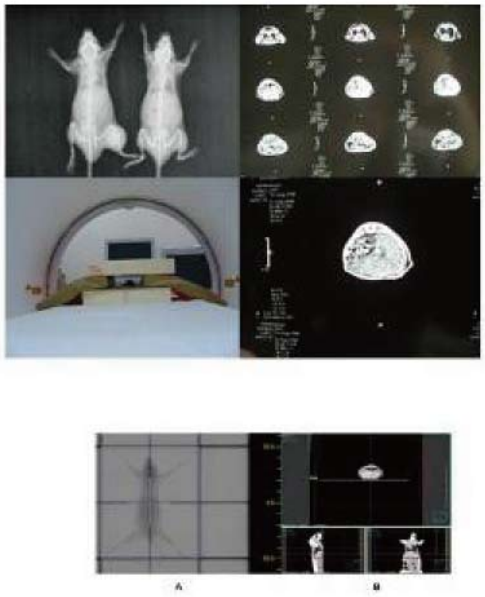
Radiation Physics and Biology Lab.

本實驗室由成佳憲副教授於2002年起隨同整建臺大醫院腫瘤醫學部放射腫瘤科時設立，主要從事放射治療物理學與放射生物學相關研究，目前以設備技術物理與腫瘤放射治療轉譯醫學等領域為研究重點。本實驗室在影像導引放射治療領域與肝癌放射治療領域已產出許多具體貢獻。本實驗室之成員來自臺大醫院腫瘤醫學部放射腫瘤科醫學物理師、放射師及放射生物醫學領域研究人員，多年來亦積極與國內外單位進行合作。

The laboratory for radiation physics and biology was established by Jason Chia-Hsien Cheng, M.D., M.S., Ph.D., with the reconstruction of Division of Radiation Oncology, Department of Oncology, National Taiwan University Hospital. The main research directions are radiation physics related to equipment and technique, as well as translational medicine of radiation oncology. Our research team has been contributing significantly the progress in image-guided radiation therapy and radiotherapy to hepatocellular carcinoma. The team members of our laboratory include the radiation physicists, radiation technologists, and radiation biologists from Division of Radiation Oncology. The laboratory also has the collaboration with the other research teams in Taiwan and in the other countries.





主要研究領域 Major Research Areas

放射腫瘤學、放射物理學、放射生物學、癌症轉譯醫學

Radiation Oncology, Radiation Physics, Radiation Biology, Cancer Translational Medicine

研究計畫 Research Projects

1. 肝臟放射治療激發之介白素6 於肝癌控制與副作用預防的功能與機轉研究
   The functional and mechanism study of interleukin-6 from liver radiotherapy for therapeutic intervention on hepatocellular carcinoma control and side effect prevention
2. 以小鼠肺癌模式作為放射線活化癌症轉移之MMP-9/MMP-2角色
   Mechanism study of radiation induced lung metastasis-the role of MMP-9/MMP-2
3. 放射線引發血管內皮細胞產生介白素-8的作用機轉及其生物效應研究
   Biological effect and mechanism of radiation-induced interleukin-8 from endothelial cells
4. Cetuximab與Bevacizumab合併FOLFOX化療與放射線治療對直腸癌治療協同效果之分子機轉探討
   Molecular Mechanism Study of Synergism with Combined Radiation, FOLFOX, and Cetuximab versus Bevacizumab on Rectal Cancer
5. 食道鱗狀上皮細胞癌表皮生長因子接受體之訊息途徑與放射治療抵抗性之機轉研究
   Mechanisms of radiation resistance by epidermal growth factor receptor signaling pathway in esophageal squamous cell carcinoma
6. 建立原位食道鱗狀上皮細胞癌動物模式研究合併表皮生長因子抑制劑與放射治療之治療效果
   Establishment of animal model with orthotopic esophageal squamous cell carcinoma to study the therapeutic effect of combining epidermal growth receptor inhibitor and radiation therapy

計畫名稱：肝臟放射治療激發之介白素6 於肝癌控制與副作用預防的功能與機轉研究

補助單位：行政院國家科學委員會

計畫期間：2010/08/01 ~ 2013/07/31

近年來由於放射治療技術與物理劑量學上的進展，放射線治療逐漸成為肝癌病患或其他部位腫瘤轉移到肝臟的治療方法之一。臨床上的研究顯示，血清中的介白素六會在肝臟接受放射線治療的療程中上升，然而介白素六的上升原因及其在肝臟放射線治療的生物意義目前仍不清楚。介白素六是具有多種效應的因子，在先前的研究中已經被發現介白素六剔除會使得小鼠的肝臟修復功能大幅下降，也有研究則顯示介白素六對肝癌細胞具有抗凋亡的效用。另一方面以介白素六及其相關訊息傳遞途徑為標的的標靶藥物也推陳出新，由於標靶藥物與放射線治療併用在腫瘤轉譯醫學的發展，使我們認為釐清介白素六在肝臟或肝腫瘤放射線治療的角色，確實是臨床上攸關肝臟受放射線照射後安全與治療效果的重要課題。

過去幾年，我們已經發表建立了小鼠肝臟部位及肝臟腫瘤的放射線治療平台，並以人類B型病毒基因轉殖小鼠探討放射腺誘發病毒複製與介白素六的相關性，以及血管內皮細胞受放射線照射產生介白素六的機轉，確認小鼠的肝臟放射線治療會如同在人類血清中觀察到的介白素六的上升，先期研究並已建立以Tetracycline 啓動基因轉殖小鼠介白素六活化的實驗動物。因此在本研究中，我們主要將運用已經建立的照射平台以免疫完整的小鼠探討介白素六在放射線治療中對正常肝組織的生理與病理效應，以及介白素六對肝腫瘤的治療作用影響。

三年期計畫中的分年目標與研究步驟分別為：第一年釐清放射線治療活體情況下介白素六對正常肝組織與肝腫瘤的效應。主要的研究策略為使用小鼠活體肝臟放射線治療模式配合自體介白素六狀態，誘發介白素六過度表現，及抑制介白素六等狀態，區分介白素六對正常肝臟組織與肝腫瘤的病理效應，與B型病毒基因轉殖小鼠之病毒活化程度影響，並以細胞凋亡、增生，及細胞週期之相關蛋白為定量定性指標。第二年的研究目標為利用體外細胞模式探討介白素六的產生來源細胞，及其對不同肝臟組成細胞在放射線照射情況下的作用機轉。主要的研究策略為分離各種肝臟組成細胞並以分子生物及化學抑制劑阻斷方法釐清介白素六對不同肝臟組成細胞在放射線照射情況下的角色。第三年的研究目標為建立追蹤介白素六表現的方法，並探討以前二年研究結果的介白素六及其相關途徑，介入為治療標的的方法，測試其在肝臟放射治療應用之可行性，主要的研究策略為以介白素六promoter連接冷光訊號的基因轉殖鼠，建立可偵測介白素六活化的分子影像模式。嘗試介白素六抗體及其受體抑制劑、下游訊息阻斷劑與放射治療併用，定性定量正常肝組織損傷與肝腫瘤控制情況的差別，以評估這些方式應用於肝臟放射治療之可能性。

預期本三年期計畫能提供肝臟放射線治療後產生介白素六的來源，功能，與機轉，如可適切的開發新的分子標靶藥物進行併用，將對肝癌放射治療具重大意義，也將對肝臟放射生物的基礎研究會是突破的關鍵。

Project title: The functional and mechanism study of interleukin-6 from liver radiotherapy for therapeutic intervention on hepatocellular carcinoma control and side effect prevention

Supported by: National Science Council
Project period: 2010/08/01 ~ 2013/07/31

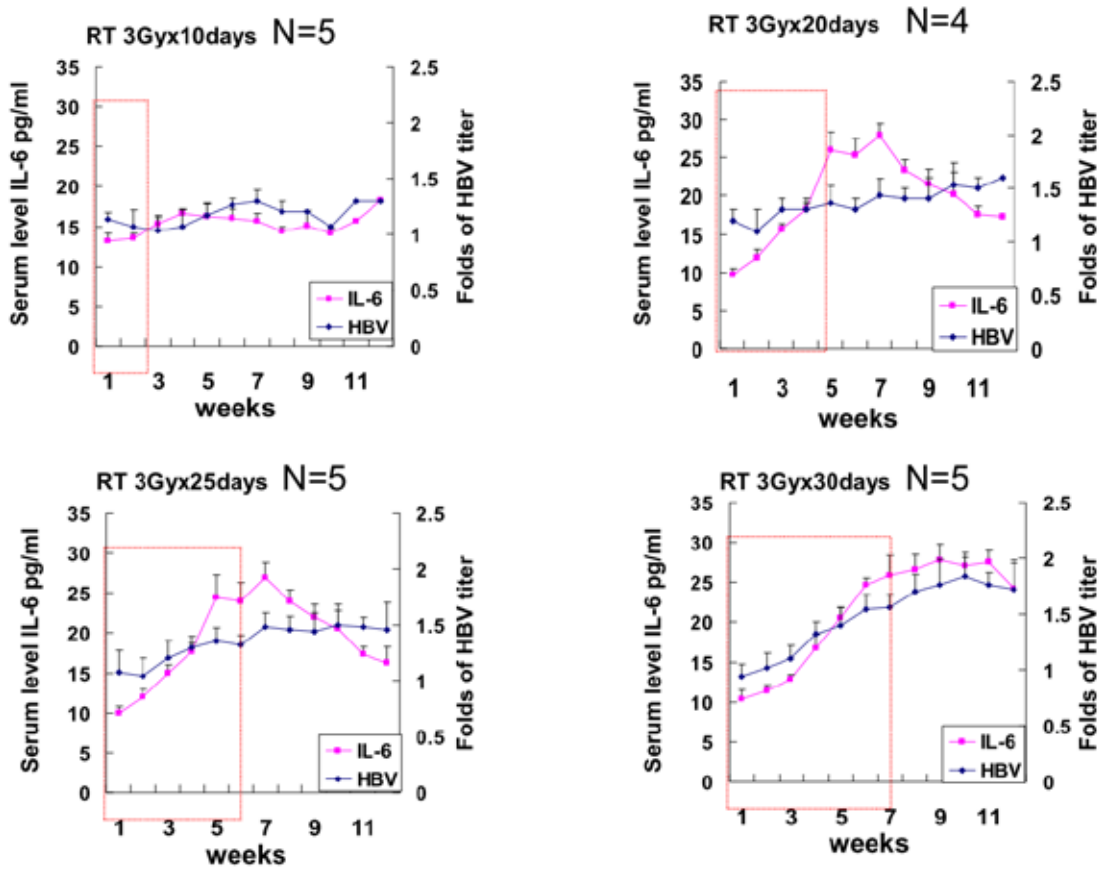
With the improved radiotherapy (RT) technology, medical physics, and dosimetry, RT has become one of the treatment options for patients with localized hepatoccellular arcimoma (HCC) or liver metastasis. Clinical studies have shown that serum interleukin-6 (IL-6) level is elevated during the hepatic RT. However, the mechanism and the effect of this elevated IL-6 are not clear. IL-6 is a multi-functional factor. The regenerative function of liver is lost in the IL-6 knockout mice. Meanwhile, IL-6 is also found to enhance the anti-apoptotic effect on HCC cells. Nowadays, many molecular targeting drugs on IL-6 or on the downstream signaling pathways have been developed. Furthermore, the combination of molecular targeting drugs and RT is evolving in the translational research. We think it necessary to clarify the role of IL-6 in liver radiotherapy. It would be an important issue for not only the safety of liver RT but also the therapeutic effect on HCC.

Our laboratory has established the platform for normal liver or orthotopic liver tumor RT on the mouse model. We published the data of defining the role of IL-6 on hepatitis B virus (HBV) reactivation in HBV transgenic mice, as well as the molecular mechanism and function of RT induced IL-6 in endothelial cells. We also demonstrated the elevated serum IL-6 level during the liver RT in mice, which is similarly found in human study. To prepare this project, we have established a transgenic mouse model with IL-6 activation by tetracycline. We plan to evaluate the physiological and pathological effect of IL-6 on normal liver, and the therapeutic impact of IL-6 on HCC by use of the established systems.

In the first year, we will focus on the effect of IL-6 on normal liver tissue and HCC treated with RT in vivo. The steps are to combine the liver RT with different types of mice, with native IL-6, IL-6 over-expression, and IL-6 inhibition. The effect is investigated by the pathological features and the molecular mechanisms of cell apoptosis, proliferation, cell cycle, and HBV reactivation. In the second year, we will in vitro define the source and function of IL-6 on different cells in liver and HCC cells. The step is to intervene the signaling pathways of IL-6 by molecular ways and chemical inhibitors with the isolated parenchymal and non-parenchymal cells. In the third year, we will establish the molecular image for the expression of IL-6, and study the therapeutic strategy of combining RT with IL-6 related targeting drugs based on the first two-year data. A transgenic mouse with the IL-6 promoter driven luciferase gene will be developed.

We expect these results may discover the source, mechanism, and function of IL-6 in liver RT, and be essential for liver radiobiology. They may also help appropriately combine IL-6 related targeting drugs with RT to HCC.

代表圖及中英文說明：



Effects of liver irradiation on the HBV titer and IL-6 concentration in serum of HBV transgenic mice.

本圖顯示B型肝炎病毒轉殖鼠接受肝臟放射治療後血清介白素六與B型肝炎病毒量關係圖。

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主要研究領域 Major Research Areas

生醫信號處理、醫學資訊系統及醫學健康教育數位學習
biomedical signal processing, medical information system, e-learning in medical and health education

研究計畫 Research Projects

1. 家庭式攜帶型(homecare)健康檢測儀之開發-功能指標AST(GOT)/ALT(GPT)監測系統
   The development of the homecare health detector – function indicator AST (GOT) /ALT(GPT) monitoring system

2. 跌倒防制之雙六軸平衡訓練系統整合研
   The Integration and Development of Dual Stewart's Balance Training System for Prevention of Fall

計畫名稱：家庭式攜帶型(homecare)健康檢測儀之開發-功能指標AST(GOT)/ALT(GPT)監測系統
Project name：The development of the homecare health detector – function indicator AST (GOT) / ALT(GPT) monitoring system
補助單位：學術領域全面提升計畫
Subsidiary organization：The project of advancement in academic fields

肝癌在世界上是最常見的癌症。肝癌是致命的癌症，因此一旦罹患癌症的病患其生命大多不超過一年。世界衛生組織在1990年估計全世界約有四十三萬新增案例，且全球約43萬死於肝癌。其中有3/4的病患集中在東南亞(中國，香港，台灣，朝鮮和日本)。這顯示肝癌發生率在亞洲是比其他地區還要高，這是因為肝癌與慢性B型肝炎感染有密切相關。肝功能是目前常用的檢驗病患肝是否正常的指標。肝臟一旦受損，在血液中天冬胺酸轉胺酶(Aspartate Aminotransferase, AST)，丙胺酸轉移酶(Alanine Aminotransferase, ALT)，丙麥胺酸轉轉移酶(Gamma Glutamyl Transpeptidase, GGT)和α-胎兒蛋白(α-Fetoprotein, AFP)這些酵素都會有上升的

趨勢。因此肝細胞大量死亡時這些酵素或者相關蛋白全部都會從肝細胞釋放到血液中。冬胺酸轉胺酶(AST)雖然是反映出對肝細胞的損害，但是並非是特異性高的酵素。丙胺酸轉移酶(ALT)僅在肝細胞中產生，因此當肝細胞受到損傷或者死亡時，血液中的丙胺酸轉移酶(ALT)就會因此而上升。除此之外，任何造成肝細胞損傷的疾病都會使得血液中丙胺酸轉移酶(ALT)濃度上升。因此藉著丙胺酸轉移酶(ALT)的靈敏度，丙胺酸轉移酶(ALT)是一個很好的肝功能指標。

“預防勝於治療”這觀念必須植入在每個人心裡，因此定期性的健康檢查便可以使人遠離肝癌且能使肝的功能能長久進而使人的壽命變長。為了此目的，我們結合生物化學、臨床醫學及電子三大領域來研製肝功能監控系統，此系統命名為“Liver function meter (或簡稱 Lifemeter)”。此系統可以量測兩個重要肝功能酵素指標：天冬胺酸轉胺酶(Aspartate Aminotransferase, AST)及丙胺酸轉移酶(Alanine Aminotransferase, ALT)。此外居家照護是現在及未來醫學檢測上的方式，因此此系統結合了無線技術，將量測的數值記錄下來並藉由無線技術傳至醫療院所，使得醫護人員即時監控病患的健康狀況。

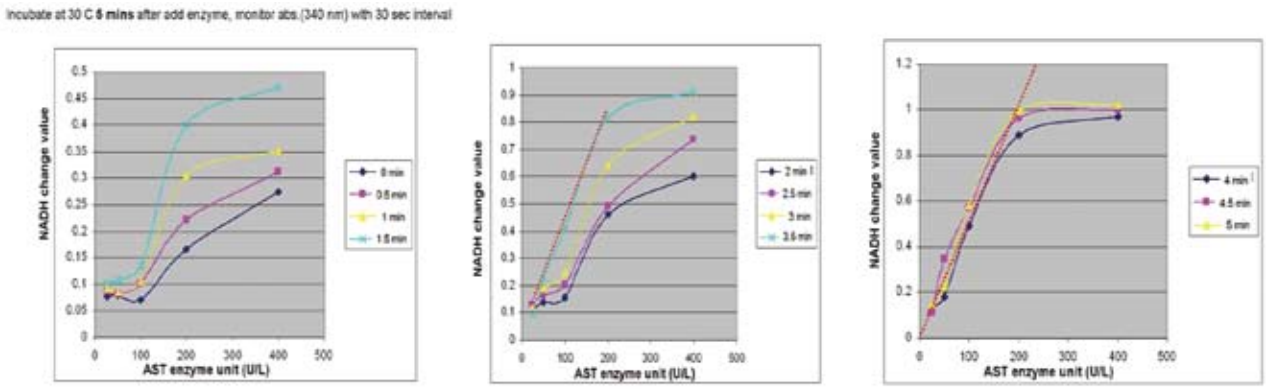
The liver cancer is the most common cancer in the world. Since liver cancer is deadly, patients suffering from cancer rarely last for more than one year. The World Health Organization estimated that in 1990 there were approximately 430,000 new cases around the world. About 430,000 died because of the liver cancer; among these patients 3/4 of them are in the Southeast Asia (China, Hong Kong, Taiwan, Korea and Japan). This shows that the chance of having liver cancer in Asia is higher than that in other regions, because liver cancer and infected chronic hepatitis B are closely related. Liver function is the most commonly used indicator to assess the condition of the patient's liver. Once liver is damaged, Aspartate Aminotransferase(AST), Alanine Aminotransferase(ALT), Gamma Glutamyl Transpeptidase(GGT) and α-Fetoprotein(AFP) in blood, will all tend to rise. So these ferments or relevant albumens will all be released from liver cell in blood when a large amount of liver cells die. Though Aspartate Aminotransferase(AST) reflects the harm to the liver cell, it is not a peculiar high ferment. Alanine Aminotransferase(ALT) is produced only in the liver cell, so while the liver cell is damaged or die, Alanine Aminotransferase(ALT) in blood will thereby rise. In addition, any disease that causes liver cell damage will make the concentration of Alanine Aminotransferase(ALT) in blood rises. So the sensitivity of Alanine Aminotransferase(ALT) makes it a very good indicator of liver function.

The idea of "prevention is better than treatment" must be kept in mind. Regular health examination can prevent people from liver cancer and can prolong the function of the liver as well as human life-span. For this purpose, we combine three major fields of biochemistry, clinical medicine and electron to develop the monitoring system of liver function, which is named "Liver function meter (or abbreviated as Lifemeter)". This system can examine two important liver function ferment indicators：Aspartate Aminotransferase(AST) and Alanine

Aminotransferase(ALT). In addition, since homecare is the current and future medical measurement, this system combined wireless technology to record the data of measurement and transmit them to the medical institutes by wireless technology. This enables medical staff to monitor the patient's health condition at any time.

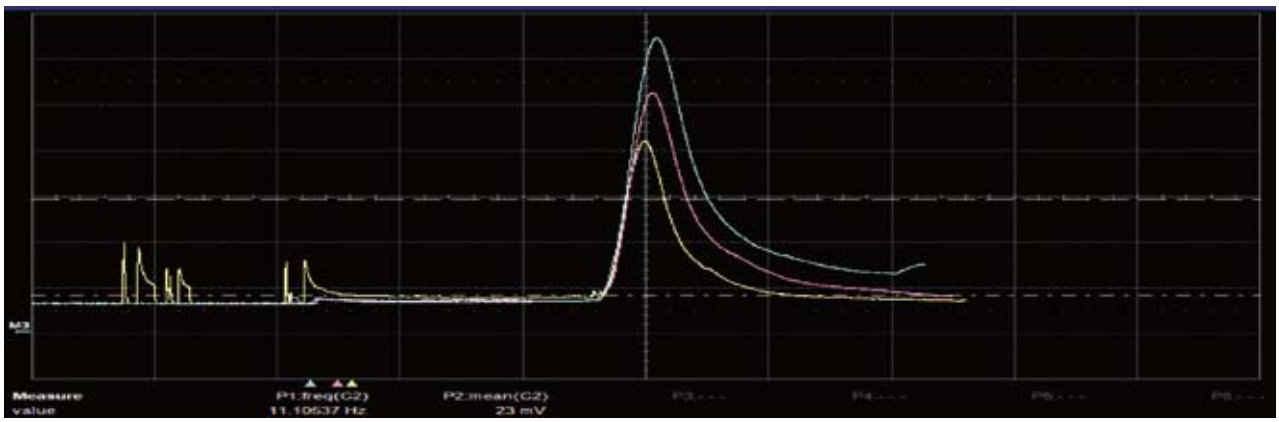
代表圖:

Representative figure：



此圖為不同單位的酵素在不同時間下所量測到的化學反應，可觀測到一致性的變化

This figure shows the chemical reaction measured at different time and on different ferment of units, which allows for the examination of the consistency of change.



此為在不同膽固醇濃度下 在示波器所呈現的波形，已經具有足夠的解析度計算對應的數值

This is in the wave form that the oscillograph appears under the concentration of different cholesterol. This has enough resolution to calculate corresponding value

計畫名稱: 跌倒防制之雙六軸平衡訓練系統整合研究

The Integration and Development of Dual Stewart's BalanceTraining System for Prevention of Fall

根據多份研究，平衡訓練系統對於老年人、中風患者以及麻痺患者有著相當程度的幫助，除了有助於提升病患的生活品質，更藉著訓練以降低跌倒的發生率，進而節省整體醫療成本的付出。

就國內外文獻，評估老年人平衡狀態可分為三大指標模式，「堅硬平台模式(Hard Plat, HP)」、「柔軟平台模式(Soft Plat, SP)」、「移動干擾模式(Sway-Referenced Support, SRS)」，然而在現有的平衡儀對於上述三大指標模式無法作有效且客觀的評估，在老人跌倒預防上著力有限。

本計劃欲建構一復健系統，以史都華平台作為基礎硬體，利用其穩定與精密的特性，製造出不同的平衡環境。並使六自由度力與力矩感測器(6 DOF force/torque sensor) 與3D追蹤器(3D tracker) 詳細記錄平衡時的二維壓力中心(Center of Pressure, COP)與重力中心(Center of Gravity, COG)，以提供客觀的平衡數據，為老人跌倒防制尋找一個更有系統的評估機制。再者，搭配者虛擬實境(Virtual Reality, VR)並輔以視覺與聽覺的回饋，使本系統的發展與應用範圍更加的廣泛。

相較於坊間的平衡系統，本計畫系統具有下列優點：

(1)相較於一般平衡儀，本系統具有更多元的平衡環境選擇。

(2)相較於已上市機械式平衡儀，本系統造價較低，且軟體配合度更高。

(3)本系統可搭配虛擬實境，並可藉由家用電腦擴充為遠距復健系統。

(4)本系統硬體自由度高，可藉由撰寫驅動軟體滿足多元復健需求。

(5)本系統採雙平台系統，相較於單平台系統，在硬體效能與靈活度更具優勢。

關鍵詞：平衡系統、平衡表現、站立平衡

Previous reports in the literature demonstrated balance training can help improve the quality of life for elderly people, stroke survivors, and paraplegic patients. In addition, balance training can decrease the occurrence of falling and then decrease the cost of the whole health system.

It has been documented that balance assessment for elderly can classify into three standard models: Hard Plat (PH), Soft Plat (SP), and Sway-Referenced Support (SRS). However, current balance equipments can't provide sensitive effective and objective evaluation for the three models, so it's hard to avoid efficiently falling of the elderly.

Our project is to set up a rehabilitation system with Stewart-Platform which can be set into different balance situations. Static and precise are the advantages of this system.6 DOF force/ torque sensor and 3D tracker are used to record the path of Center of Pressure (COP) and Center of Gravity (COG) in plane for objective database about balance assessment. This database can help us to develop the better system for balance assessment about flopping of the elder. Beside, combining with Virtual Reality (VR) and the feedback of vision and auditory can increase the development and application of our system.

Comparing with others, the advantages of our system are：

1. Our system has more diversified balance situation than present ones.
2. Comparing with present mechanical devices, our system with software is more economic and more friendly.
3. Our system can combine with virtual reality to become a distant rehabilitation system by personal computer.
4. For different requirements of rehabilitation, our system can work easily with other hardware by custom-made drivers.
5. Our project use two-plats system which can improve the efficiency of hardware and adaptability.

Keyword：Balance System, Balance performance, Standing B

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生物資訊暨生物統計核心實驗室
Bioinformatics and Biostatistics Core Lab.

本實驗室研究是以基因體學探討癌症形成機制為主軸。近年來基因晶片 (DNA microarray) 已經被廣泛應用在同時觀察大量的基因表現，為研究特定基因調控極為方便、快速與可靠的方法。因此實驗室的研究方向乃致力於增進基因晶片技術在生物醫學領域上的研究，研究範疇涵蓋晶片製備技術、影像擷取與分析、生物資訊學、資料管理，以及利用基因晶片分析技術來解析致癌基因複雜的調控關係，探討基因表現或基因突變與細胞反應的關連。長遠的目標為藉由基因體研究找尋特定的癌症分子指標，將來作為癌症治療與診斷的標的。

The focus of our laboratory is using genomic approaches to investigate the mechanisms of carcinogenesis. DNA microarray has been applied widely in simultaneously monitoring a large quantity of gene expression patterns and served as a convenient, quick, and reliable method to investigate specific gene regulation. Therefore, our lab devotes to the application of microarray technology in the biomedical field. Interests in our laboratory include microarray fabrication, image capture and analysis, bioinformatics, database management, and analytic technique to understand the complicated regulatory mechanisms of cancer related genes as well as the correlation between gene expression or gene mutation and cellular response. Our long-term goals are via genomic study to identify specific cancer molecules as biomarkers for the targets of cancer therapy and diagnosis.

主要研究領域 Major Research Areas

生物晶片、生物資訊、癌症生物、輻射生物
Biochip, Bioinformatics, Cancer Biology, Radiation Biology

研究計畫 Research Projects

1. IGFBP5 與幅射線誘發相關效應之研究
   Study the relationship between IGFBP5 and radiation-induced effects
2. 優勢重點領域拔尖計畫-醫學卓越研究中心-生物資訊暨生物統計核心實驗室
   Bioinformatics and Biostatistics Core Facility
3. 研究不同輻射敏感性之肺癌細胞受輻射誘導後之基因表現改變以及探討 Notch pathway 如何影響肺癌細胞CL1-0與CL1-5 之輻射敏感性
   To study radiation-induced genomic instability and gene expression profiles in lung cancer cells with differential radiosensitivity and to investigate how HLJ1 modulates radiosensitivity in the lung cancer cell line CL1-0 and CL1-5
4. 微核醣核酸調控機制與其作用標的之預測
   Target prediction and regulation of microRNAs
5. 以基因體方式篩選台灣非吸菸女性肺癌病患甲基化變異
   Genome-wide Screening of Methylation Profiles in Non-smoking Female Lung Cancer in Taiwan

計畫名稱：IGFBP5 與幅射線誘發相關效應之研究
補助單位：行政院國家科學委員會
計畫期間：2011/08-2012/07

從許多的報告中已知輻射線照射主要會造成 DNA 傷害，進而誘發許多細胞反應包含細胞週期停止，細胞死亡或是細胞轉變。然而，從先前的研究中發現罹患遺傳性視網膜母細胞瘤的孩童，其外表正常雙親之皮膚纖維母細胞對游離放射線產生預期外的高放射線敏感現象。因此我們認為罹患遺傳性視網膜母細胞瘤的孩童的雙親之皮膚纖維母細胞，可能有還未被發現的基因調控機制與輻射線誘發相關細胞效應有關。從我們在2006 年發表於Cancer Research 期刊中的研究指出，利用 DNA 微陣列晶片技術，我們分析並挑選出 42 個與游離輻射誘發細胞敏感有關之基因。 在這些42個基因當中，IGFBP5 (Insulin-like growth factor binding protein 5)，其主要功能是與 insulin growthfactor (IGF) 結合進而調節 IGF 的功能，被選出作進一步研究其在人類皮膚細胞中與輻射敏感度效應之關係。在我們前期的實驗中發現，短期大量表現 IGFBP5 之人類纖維母細胞 (Hs68) ，對於游離輻射有較高的耐受性。此結果說明 IGFBP5 的確與人類皮膚纖維母細胞之游離輻射敏感度有關。因此，在本計畫中，我們將藉由穩定表現或是穩定抑制 IGFBP5 的人類細胞株來進一步探討 IGFBP5 與游離輻射誘發之各種細胞效應

之間的關係。於第二年中，我們將要利用微陣列晶片技術來探討游離輻射所引發之IGFBP5 訊號傳遞路徑。最後，我們將利用 IGFBP5 的基因剔除鼠來進行游離輻射線對於IGFBP5 基因剔除鼠的效應。藉由細胞與動物實驗的研究，可以幫助我們了解 IGFBP5與其下游基因對於游離輻射所引發細胞反應之間的關係。

Project title: Study the relationship between IGFBP5 and radiation-induced effects
Supported by: National Science Council
Project period: 2011/08-2012/07

It is well known that ionizing radiation exposure can cause DNA damages, which are associated with series of cellular responses including cell cycle arrest, transformation, and cell death. However, an unanticipated radiation-induced hypersensitivity in normal skin fibroblasts derived from unaffected parents of children with hereditary retinoblastoma was discovered several years ago. In our previous study published in Cancer Research, 42 differentially expressed genes were identified as radiosensitivity related genes. Among those 42 genes, insulin-like growth factor binding protein 5 (IGFBP5), which functions as a carrier protein to regulate the activity of insulin-like growth factors (IGFs), is chosen for further investigation in human fibroblast cells. Our preliminary data showed that normal human fibroblast (Hs68) with transient IGFBP5 overexpression significantly increased the survival after irradiation compared to control cells. The result indicated that IGFBP5 may play a role in radiation-induced cytotoxicity. Therefore, in this study, we would like to establish IGFBP5 overexpressed or silenced normal human fibroblasts for further characterizing the relationship between IGFBP5 and radiation-induced effects. Moreover, DNA microarray analysis will be applied to study the signaling pathways of IGFBP5 in the cells with or without radiation treatment. The IGFBP5 knockout animal model will also be setup to investigate the function of IGFBP5 in response to radiation in vivo. Taken together, results from the cell and animal studies may help to better understand the role of IGFBP5 and its downstream signaling pathways in response to ionizing radiation.

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Magnetic Resonance in Medicine Lab.

成立於2000年7月，指導教授為鍾孝文教授，目前計有博士班研究生15名，碩士班研究生1名。博士班畢業生18名，碩士班畢業生12名。目前進行中的研究主要有以下幾項：

1. 抗壞血酸之臨床磁振頻譜檢測技術開發

   抗壞血酸為人體內重要的抗氧化劑。本計畫預期以虛擬滴定、純量偶合頻譜編輯、巡弋迴訊運動校正等方式進行人體氫原子核磁振頻譜之活體腦部抗壞血酸檢測，並探討其精確度。

2. 數據共享之動態磁振造影加速

   本計畫針對動態磁振造影，擬以影片壓縮演算法、多心跳週期Unpack技術等數據共享法則，研發一系列動態影像加速擷取與影像重建之技術，以加速五至八倍為目標，並適用於型態變異與對比改變兩種不同之模式。

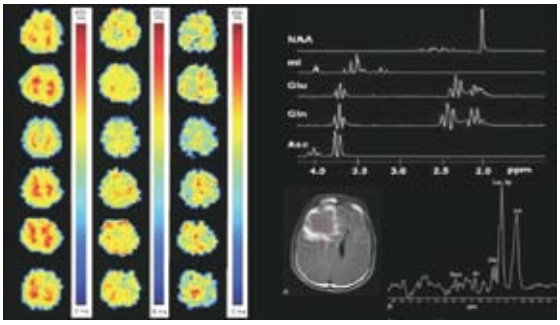
Founded in July 2000. Supervisor: Prof. Hsiao-Wen Chung. This lab currently (2010) has 15 Ph.D. students and 1 M.S. student, plus 18 Ph.D. graduates and 12 M.S. graduates. Research topics include:

1. MR spectroscopic techniques for ascorbic acid detection.

   Ascorbic acid is an important anti-oxidant in the human body. This project aims to use virtual titration, J-coupling spectral editing, and navigator echo motion correction techniques to explore the accuracy of proton MRS for ascorbic acid detection in the human brain in vivo.

2. Acceleration of dynamic MRI via data sharing.

   This project proposes data sharing methods using video compression principles and multiple cardiac phase Unpack techniques to reconstruct dynamic images with accelerated acquisition. Methods suitable for either morphological variations or contrast changes are developed, aiming at acceleration factors up to 5 or 8.



主要研究領域 Major Research Areas

醫用磁振造影
Biomedical magnetic resonance imaging

研究計畫 Research Projects

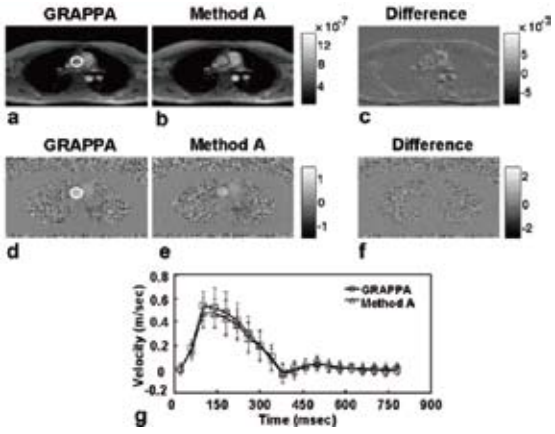
1. 數據共享之動態磁振造影加速
   Acceleration of dynamic MRI via data sharing.
2. 抗壞血酸之臨床磁振頻譜檢測技術開發
   Developments of clinical magnetic resonance spectroscopic techniques for the detection of ascorbic acids.

計畫名稱：數據共享之動態磁振造影加速
補助單位：行政院國家科學委員會工程處
計畫期間：2010/08/01-2013/07/30

本計畫為三年期前瞻性研究。重點在於動態磁振造影研發一系列加速擷取與影像重建之技術，利用各式數據共享演算法，在不明顯損失影像品質與診斷資訊前提下，以加速五至八倍為目標。三年間計畫之特定目標為：一、發展以影片壓縮技術為主軸的動態心臟磁振造影重建方式，並且不使用複雜隨機取樣以避免平衡穩定態自由旋進擷取技術之特有假影。同時亦根據重建法則，發展加速之心臟影像擷取技術。二、推展上述加速擷取原理，利用本研究群所提出之Unpack原理進行多心跳週期之動態影像，以進一步提高時間空間數據稀疏特性之利用效率。三、針對注射顯影劑之動態磁振造影與大腦功能性磁振造影（以上皆為型態類似但對比顯著變化之案例），提出不同的數據共享重建演算法，以達到與上述心臟影像（型態顯著變化但對比類似）近似的加速幅度。四、持續改進已特定設計之多因子評估方式，並依此比較上述發展之影像加速技術，提供臨床使用者作為標的適合性與最佳化應用之指引。本計畫之預期成果，短期內應可顯著提升臨床動態磁振造影之取像速度；長期方面，則將可望能發展出有助未來基礎與臨床放射診斷之新穎技術。

相位對比磁振造影對主動脈做流速分析之實驗結果。以商用化之 GRAPPA 與本研究所採用之加速方式 Method A 所得到之原始影像（a,b）以及對應之流速分佈圖（d,e）相比較，極為微小的差異（c,f）充分顯示出改變自動校正信號（ACS）擷取形式之可行性。（g）主動脈在心跳週期中以兩種方式所取得之流速變化情形。白色部份為流速量測之區域。

代表圖及中英文說明：



The results of a direct implementation of accelerated phase-contrast MR imaging (Method A) for acquiring aortic flow. The comparable magnitude images (a,b) and phase images (d,e) of GRAPPA and Method A, reflected by a minor difference (c,f) in between, indicate the feasibility of the modification of ACS sampling pattern. g: The quantified velocity curves of GRAPPA and Method A. White circle: ROI for velocity quantification.

Project title: Acceleration of dynamic MRI via data sharing
Supported by: National Science Council, Engineering Division
Project period: 2010/08/01-2013/07/31

This is a three-year prospective project on a series of technical developments related to acquisition design and post-acquisition reconstruction of dynamic magnetic resonance (MR) imaging, with the aims to accelerate acquisition by a factor of five to eight without substantial loss of image quality and diagnostic information via various data sharing approaches. Chronologically, we shall accomplish the following specific aims: 1. We shall develop computational methods fully based on video compression techniques to design suitable strategies for cine cardiac MR imaging acceleration without using complicated random sampling pattern that could hurdle balanced SSFP imaging. We shall also develop cine cardiac imaging acquisition methods in accordance with the reconstruction algorithms. 2. We shall advance the acceleration principles to multi-cycle cardiac imaging using the Unpack principles, such that the utilization of spatial-temporal sparse pattern can be achieved at an even higher efficiency. 3. We shall propose data sharing reconstruction algorithms distinct from the above (similar contrast with different morphology) to accomplish similar acceleration rates for dynamic contrast-enhanced perfusion MR examinations and brain functional studies (different contrast with similar morphology). 4. We shall compare the performance of these acceleration methods using specially designed multi-factor evaluation methods, which will be under continuous refinements throughout execution of this project, such that the suitability of each individual method can be optimally realized by potential users in clinical practice. The anticipated results from this study, in the short term, should substantially increase the frame rate for clinical dynamic MR imaging acquisition. In the long term, a successful execution of this project should lead to novel technical improvements whose outcomes are potentially helpful for both basic and clinical radiological investigations.

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數位相機與電腦視覺實驗室
Digital Camera and Computer Vision Lab.

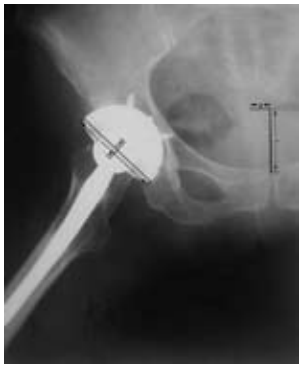
本實驗室由傅楸善教授成立於2003年，主要從事數位相機與電腦視覺相關研究。歷年來已執行多項研究計畫，目前以生醫數位相機、影像處理與自動光學檢測等領域為研究重點。本實驗室在上述領域已產出許多具體貢獻並在全世界有很高之能見度。此外，本實驗室之成員來自電子、資訊及醫學等各領域，多年來亦積極與國內外單位進行合作，合作夥伴包括產、研、學各界，例如：光寶科技、致伸科技、太欣半導體、創惟科技、由田新技、德律科技等。提升數位相機與自動光學檢測技術及其生醫應用，是本實驗室之成立宗旨與具體目標。

Digital Camera and Computer Vision Laboratory was founded by Professor Chiou-Shann Fuh in 2003, with the main research focus in digital camera and computer vision. In the past few years, we have conducted a number of research projects in digital image processing and automatic optical inspection. We have also made several critical contributions and are now one of the most visible research laboratories in this field in the world. Members of the laboratory come from various backgrounds, including electronics, informatics, and medicine. We have also been actively collaborating with research laboratories throughout the world, covering industry, research institutes and universities, from basic sciences, engineering to clinical research, such as Liteon, Primax Electronics, Genesys Logic, Syntek Semiconductor, Utechzone, and TRI. Integrating multi-disciplinary research efforts, exploring advanced digital camera with biomedical applications, and automatic optical inspection is the mission of this laboratory.

主要研究領域 Major Research Areas

數位相機、電腦視覺、自動光學檢測、數位影像處理
Digital Camera, Computer Vision, Automatic Optical Inspection, Digital Image Processing

研究計畫 Research Projects



1. 數位相機之影像處理：降低雜訊、光線補償、臉色改善
   Image Processing for Digital Cameras: Noise Reduction, Light Compensation, Facial Color Enhancement
2. 數位相機之影像處理：色彩內插、色彩校正、色彩管理
   Digital Image Processing for Camera: Color Interpolation, Color Calibration, Color Management
3. 行動視訊高畫質顯示調適技術
   High Quality Display Adaptation Technique for Mobile Video Device
4. 視訊會議使用的相機陣列
   Camera Array for Video Conferencing

計畫名稱：數位相機之影像處理：降低雜訊、光線補償、臉色改善
補助單位：行政院國家科學委員會
計畫期間：2009/08/01-2012/07/31

本計畫為期三年、目的是研究利用電腦視覺與數位影像處理方法，進行數位相機降低雜訊(Noise Reduction)、光線補償(Light Compensation)、臉色改善(Facial Color Enhancement)之研究。在計畫執行期間，我們將探討最佳的攝影機、光源、環境、景物及色彩的互動，第一年研究適合不同感應器(Sensor)與影像訊號處理器(ISP: Image Signal Processor)的最佳降低雜訊方法；第二年研究最適合的光線補償演算法使拍出來的影像不管是在太暗或太亮的場景下都能得到對比很清楚，層次很分明的影像；第三年研究各種臉部瑕疵及顏色的改善方法，不管是雀斑、青春痘、膚色暗沈等，改善數位相機擷取的原始影像，使得每張影像都精采，每個主角都漂亮且滿意。並突破日本及美國在這三方面的專利及技術障礙，提高我國的數位靜態相機，相機模組及視訊攝影機在國際市場的競爭力。

Project title: Image Processing for Digital Cameras: Noise Reduction, Light Compensation, Facial Color Enhancement
Supported by: National Science Council
Project period: 2009/08/01-2012/07/31

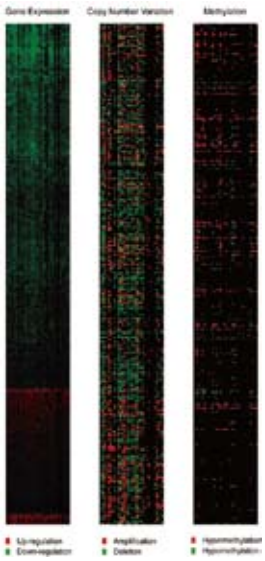
This is a three-year project to use computer vision and digital image processing methods for noise reduction, light compensation, and facial color enhancement of digital cameras. We will study the best

camera, light source, environment, scene, and color interaction. In the first year, we will develop various noise rduction methods for different sensors and image and signal processors (ISPs) to achieve optimum noise reduction. In the second year, we will research the best light compensation algorithm to achieve images with good contrast and shading even under too bright or dark scenes. In the third year, we will research various facial defect and color enhancement methods to develop programs and algorithms so that freckles, acnes, skin darkness, and incorrect color and be enhanced and eliminated from digital camera raw image and achieve beautiful subject faces and satisfactory images for each shot. We would like to break the patent and technology barriers of Japanese and American companies and to enhance and competitiveness of Taiwan companies in international markets.

代表圖及中英文說明：

階層式降雜訊:
Imagenomic Noiseware、高頻、邊、金字塔、低頻、抹平滑，希望發展成適合即時內嵌式硬體實現。
Hierarchical Noise Reduction, Imagenomic Noiseware, High Frequency, Edge, Pyramid, Low Frequency, Smoothing, Aim for Real-Time Embedded Hardware Implementation.

505個於肺癌組織中具有顯著表現量差異基因的基因表現 (GE)、拷貝數變異 (CNV) 及甲基化情形 (ME) 圖譜。在左方的基因表現圖譜中，利用單方向階層式群集法針對此505個基因於癌症及正常組織中的表現倍數變化進行分析，且相應之基因排列順序結果會應用於拷貝數變異與甲基化改變的圖譜上。於基因表現圖譜上紅色代表表現量上升，綠色代表表現量下降；於拷貝數變異圖譜上紅色代表拷貝數增加，綠色代表拷貝數減少；於甲基化改變圖譜上紅色代表高度甲基化，綠色代表低度甲基化。



Heatmaps of gene expression (GE), copy number variation (CNV), and methylation level (ME) of the 505 differentially expressed genes in tumor tissue. For gene expression (left column), one-way hierarchical clustering was performed on the expression ratios between tumor and normal tissue of the 505 dysregulated genes. Red color represents up-regulation and green color represents down-regulation. To plot their corresponding genetic modification profiles, the gene order was the same as that from gene expression clustering. For CNVs (middle column), red color indicates amplification and green color indicates deletion. For methylation level (right column), red color denotes hypermethylation and green color denotes hypomethylation.

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主要研究領域 Major Research Areas

乳房外科、乳房超音波檢查、腫瘤外科、分子流行病學
Breast Surgery, Breast Ultrasound, Tumor, Molecular Epidemiology

研究計畫 Research Projects

1. 微核醣核酸調控腫瘤進展的微環境因子與分子機制--微核醣核酸在乳癌轉移的角色探討
2. 全基因體關聯研究找到的單一核甘酸基因多形性變異與乳癌危險性，分子類型與預後的關係
3. 自動乳房超音波之電腦輔助診斷
4. 以乳房超音波及乳房攝影術進行台灣40-49歲婦女乳癌篩檢隨機試驗
5. 乳房彩色彈性超音波之電腦輔助診斷
6. 雙波段紅外線乳房影像系統之三維模型建立與血管增生定量分析
7. 乳房磁振造影電腦輔助偵測與功能性評估系統之研發
8. 家用型雙波段乳癌紅外線診斷系統
9. 微流體平台進行藥物篩選與化療療效監測
10. 經前婦女可切除乳癌之CYP19(TTTA)重複多型性研究
11. 多國多中心、開放性、分為兩組的第三期試驗，評估 bevacizumab 輔助性治療對三項標記陰性乳癌之療效
    BEATRICE (Protocol BO 20289): An international multicentre open-label 2-arm phase III trial of adjuvant bevacizumab in triple negative breast cancer
12. 隨機分配、多國多中心、第二階段的臨床試驗，針對局部晚期、發炎性，或早期 HER2 陽性之乳房腫瘤的病人， 評估trastuzumab 合併 docetaxel對trastuzumab 合併 docetaxel 及pertuzumab對trastuzumab 合併 pertuzumab治療
    A randomised, multicenter, multinational Phase II study on trastuzumab plus docetaxel versus trastuzumab plus docetaxel plus pertuzumab versus trastuzumab plus pertuzumab in patients with locally advanced, inflammatory or early stage HER2 positive breast cancer
13. 以Herceptin單一或合併Taxane療法作為第一線使用在先前HER2呈陽性初期乳癌時曾接受Herceptin輔助性治療後復發的轉移乳癌患者之第二階段臨床試驗
    Phase II study of HFerceptinÒ, alone or in combination with a taxane, as a first-line treatment for patients with metastatic breast cancer, who have relapsed after receiving Herceptin in the adjuvant setting for HER2 positive early breast cancer

14. 以Lapatinib、Trastuzumab及其組合併用paclitaxel輔助治療罹患HER2/ErbB2陽性原發性乳癌婦女之隨機、多中心、開放性第三期臨床試驗
    A randomised, multi-centre, open-label, phase III study of neoadjuvant lapatinib, trastuzumab, and their combine plus pailtaxel in women with HER-2/ErbB2 positive prrimary breast cancer
15. 一項隨機、多中心、開放性、第三期臨床試驗、研究連續與合併使永輔助性之Lapatinib與Trastuzumab於治療HER2/ErbB2陽性之原發性乳癌病患
    A randomised, multi-centre, open-label, phase III study of adjuvant lapatinib,trastuzumab, their sequence and their combination in patients with HER2/ErbB2 positive primary breast cancer
16. 第三期隨機分配之臨床試驗：比較黃體期或濾泡期進行卵巢切除術併用Tamoxifen用於停經前婦女荷爾蒙受體陽性轉移性乳癌之療效
    Phase III randomizated study of luteal phase vs follicular phase surgical oophorectomy and tamoxifen in premenopausal women with metastastic hormone receptor- positive breast cancer

計畫名稱：以乳房超音波及乳房攝影術進行台灣40-49歲婦女乳癌篩檢隨機試驗
補助單位：行政院衛生署國民健康局

台灣地區40-49歲婦女乳癌的問題相當重要，國內婦女乳癌發生率之高峰較國外年輕，主要集中在45-55歲，且年輕族群的乳癌發生率每年以相當驚人的速度在成長。然而有鑒於乳房攝影術較不適用於50歲以下之婦女，是否可使用超音波篩檢來提高效益，是相當值得探討的問題，雖然在臨床上已有許多文獻支持，不過這些發現都是基於臨床病人，而其接受超音波或乳房攝影術的原因(Indication)並非全來自篩檢，部份是因為已有症狀（如腫塊）。所以超音波檢查是否較乳房攝影術對於早期乳癌發現效益更大，亟待實證醫學評估。

本計畫之主旨在利用臨床隨機試驗證明乳房超音波與乳房攝影術對台灣地區40-49歲婦女乳癌之篩檢效益。在此研究計劃中之目的如下所述：

(一) 針對40-49歲設計一個以族群為主的隨機試驗，對乳房攝影術及乳房超音波進行下列比較：
篩檢方法敏感度及精確度比較，敏感度指標有三：
1. 相對敏感度指標：計算在診斷為乳癌個案中各種篩檢工具診斷為異常者之比例
(包括localized benign及疑似個案)
2. 計算篩檢12個月後篩檢間隔個案佔所有個案比例
3. 計算在篩檢後1年及2年內篩檢間隔個案佔基本發生率之比例

(二) 比較乳房超音波及乳房攝影術+超音波篩檢工具對於病人回診率之差異

(三) 比較兩種篩檢工具降低第二期癌症或以上之效益

(四) 比較兩種篩檢工具降低乳癌死亡率之效益

本計畫共分五年進行，內容包括進行研究中心臨床隨機分配、組織及倫理面(Organization and

Ethical Aspect)、社區公共衛生資源動員(Mobilization of Community Resources)、臨床篩檢轉介、確診流程作業標準化、大規模邀請及進行乳房攝影術與超音波篩檢(Large-scale Mass Screening)、研究中心、參與醫院、及衛生局所資訊系統之建立、早期評估超音波及乳房攝影術之轉介、回診、確診狀況、敏感度及精確度、臨床隨機分配三組間早期效益（如第二期癌症以上降低）之比較、及預測兩種篩檢（乳房超音波及乳房攝影術）乳癌死亡率之降低情形。

Project title: A population-based cross-over randomized controlled trial of breast cancer screening with alternate mammography and ultrasound for women aged 40 to 49 years in Taiwan

Supported by: Bureau of Health Promotion, Department of Health

As there is paucity of data on population-based screening for breast cancer using mammography and ultrasound for oriental young women aged 40-49 years, the peak of incidence rate and high proportion of dense breast, we aimed to evaluate the relative performance of detecting breast cancer between ultrasound and mammography and also to assess complementary efficacy of ultrasound to mammography screening.

Methods: A total of 79,691 female residents aged 40-49 years were invited from community in Taiwan since late 2003. These participants were first randomly assigned to mammography (n=20040), ultrasound (n=20088), and control group (n=39563). The two former groups were further done by a cross-over design with mammography and ultrasound on alternate year until 2008. Detection rate and annual incidence rate of interval cancer as a percentage of the control group (I/E ratio) were compared between mammography and ultrasound.

Results: The attendance rate of the first round was 59% (11921/20040) for mammography and 56% (11249/20088) for ultrasound. The repeated attendance rate of both groups was 85% in the second round and 91% in the third round. In the first round of screen, the detection rate of breast cancer for the mammography group (0.34%) was 1.5-fold compared with the ultrasound group (0.22%). The additional detection rate was 0.16% contributed from a subsequent ultrasound screen and 0.36% contributed from a subsequent mammogram screen. The combination of mammography with ultrasound was as three to four times as likely to detect breast cancer compared with the control group (annual incidence rate was 0.17%). The I/E ratio was lower after mammography screening than that after ultrasound screening.

Conclusion: The current randomized controlled trial not only demonstrated higher detection rate and better performance using mammography but also indicated the complementary role of ultrasound applied to young Taiwanese women. This further suggests the optimal screening modality for young women in Asian country is to combine mammography with ultrasound.

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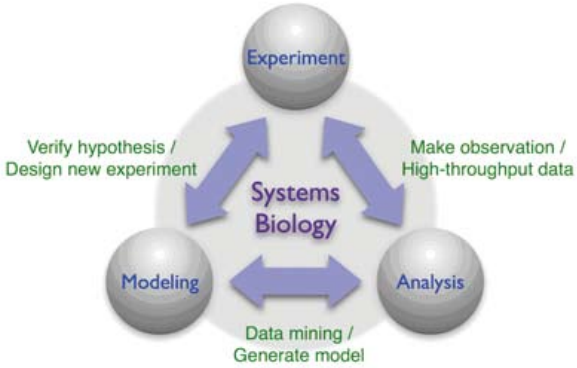
國立臺灣大學分子與細胞生物學研究所 教授

Professor, Graduate Institute of Biomedical Electronics and Bioinformatics/ Department of Life Science/ Institute of Molecular and Cellular Biology, National Taiwan University

系統生物學研究室
Systems Biology Lab.

本研究室主要以系統生物學探討藥物在癌細胞的作用機制，內容包括各蛋白質間交互作用的預測和建構、基因網絡的模擬和建構，及微型RNA於其調控的蛋白質間交互作用及網路關係，期望進一步達到開發新藥的目地。主要的目標是利用系統生物學研究法來研究在ATP合成酶抑制劑誘導下乳癌及肺癌細胞進行細胞凋亡的作用機制；同時，利用系統生物學研究法來開發新的藥物。



The main research in our lab is to apply systems biology for drug-discovery. We discover novel drugs for cancer therapy and investigate the molecular mechanism of apoptosis in drugs-induced cancer cells using systems biology approach.

MicroRNAs are short single-stranded non-coding RNA molecules which play a key role in post-transcriptional regulation of mRNAs. A miRNA can affect many downstream targets which in turn form a complicated network. Our lab has characterized the roles of miRNAs in the regulation of cellular networks and revealed that miRNA-regulated network could be used as a novel therapeutic target for cancer as well as other diseases such as neurological and cardiovascular diseases.

主要研究領域 Major Research Areas

系統生物學、蛋白質體學、生物資訊

Systems Biology, Proteomics, Bioinformatics

研究計畫 Research Projects

1. 調控ATP合成酶基因之微RNA功能及演化
   Evolution and functions of microRNAs that regulate ATP synthase subunit genes
2. 幽門桿菌感染胃癌細胞之基因網路研究：annexin A4相關的訊息傳遞及調控機制
   Gene network of host cell by Helicobacter: annexin A4 involved singalling and regulation in gastric cancer.
3. 利用系統生物學開發抗肺癌藥物：以ATP合成酶抑制劑進行標靶治療及機制探討
   Applying systems biology for anti-lung cancer drug discovery: targeting therapy by ATP synthase inhibitors and molecular mechanism study

計畫名稱：調控ATP合成酶基因之微RNA功能及演化
補助單位：行政院國家科學委員會
計畫期間：2010/08/01-2013/07/31

ATP合成酶是由DNA解旋酶和氫離子馬達結合，藉由氫離子梯度使馬達旋轉，而驅動ATP合成，這樣的旋轉機制在演化過程中效率漸增。因為ATP合成酶是一個古老的蛋白質，探討是否早在後生動物演化時，就已出現微RNA調控ATP合成酶次單體基因的現象，是一個相當有趣的議題。這些微RNA是否對這些次單體基因的表現程度有不同的影響？此影響是否會引起這些次單體表現量的平衡？我們想知道不同的微RNA是否會在相同的時間點被啓動，而當ATP合成酶的表現大量受到微RNA抑制時對細胞造成的結果又是如何？

本計畫主要的目標是要探討在演化上微RNA於ATP合成酶次單元基因調控中所扮演的角色。

特定目標：

1. 預測並實證調控人類ATP合成酶次單體基因的微RNA。
2. 闡明這些微RNA是否對ATP合成酶次單體表現程度有不同的影響，及其所造成的生物性結果為何？是否會抑制癌細胞生長？
3. 研究在動物演化的過程中，調控ATP合成酶次單體基因的微RNA及其調控網路何時被啓動？
4. 找出影響調控ATP合成酶次單體基因的微RNA轉錄因子。在動物演化過程中，這些因子何時被啓動去調控這些微RNA？

在本研究計畫中，我們期望能夠了解調控ATP合成酶次單體基因的微RNA及其網路於動物演化過程中所扮演的角色。此研究也許有助於釐清微RNA於演化的重要性。

Project title: Evolution and functions of microRNAs that regulate ATP synthase subunit genes
Supported by: National Science Council
Project period: 2010/08/01-2013/07/31

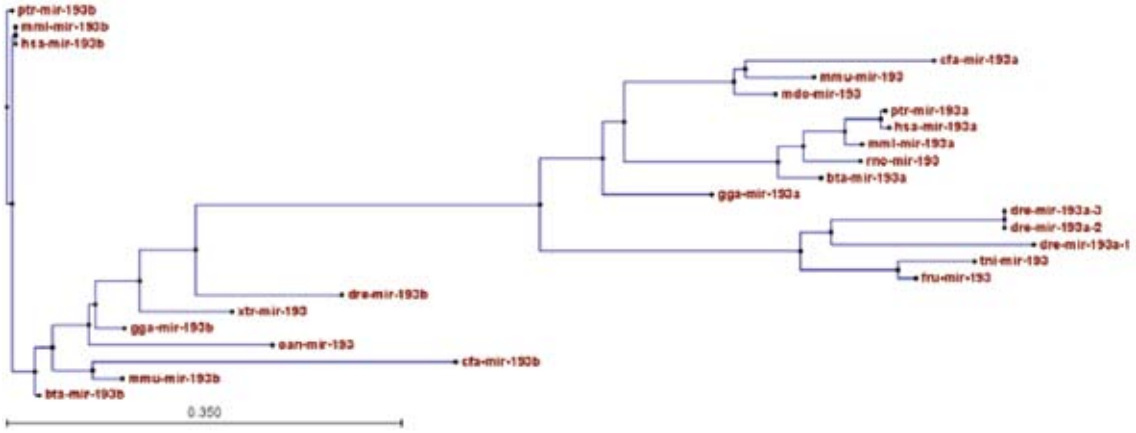
ATP synthase is a multimeric protein complex that catalyzes the synthesis of ATP. It is essential for almost all organisms because ATP is the common "energy currency" of cells. The modular evolution theory for the origin of ATP synthase suggests that two subunits with independent functions, a DNA helicase with ATPase activity and a H+ motor, were able to bind together, so the rotation of the motor drive the ATPase activity of the helicase in reverse. This would then evolve to become more efficient, and eventually develop into the complex ATP synthases seen today. Since ATP synthase is such an important protein and since it is a complex with many subunits, we are curious as to whether ATP synthase is regulated by many miRNAs. Although protein complex subunit genes tend to be less regulated by miRNAs, our predictions suggest that some ATP synthase subunit genes are targets of different miRNAs. In view of the fact that ATP synthase is an ancient protein, it is interesting to ask whether the miRNA regulation of subunit genes arose early in metazoan evolution. Another question is whether these miRNAs have very different effects on the expression levels of subunit genes, a situation that would pose a problem of dosage balance among the subunits. Indeed, when a subunit gene becomes a new miRNA target, how is the dosage balance among subunits maintained? We therefore ask if the different miRNAs were recruited at similar times. A natural question to ask is what the consequences are when the express level of ATP synthase is substantially reduced by miRNAs. A simple test is to see whether it can suppress cancer growth.

Our major objective is to provide much detail on how the role of miRNAs in ATP synthase subunit gene regulation has been expanded in evolution, especially in the lineage leading to human. Our specific aims are:

1. To predict and validate miRNAs that regulate human ATP synthase subunit genes.
2. To elucidate whether these miRNAs have very different effects on ATP synthase subunit expression levels, what are the biological consequences when the ATP synthase level is significantly reduced by miRNAs and whether it can suppress cancer growth.
3. To study when these miRNAs were recruited to regulate ATP synthase subunit genes during animal evolution and how their regulatory networks have evolved?
4. To find out the transcription factors (TFs) that regulate the key miRNA genes regulating ATP synthase subunit genes. To address the questions: "when were these TFs recruited to regulate the key miRNAs?" "Were they recruited at similar times or at very different times during animal evolution?"

With the proposed study, we expect to understand the roles of the miRNAs that regulate ATP synthase subunit genes in the evolution of regulatory networks during animal evolution. It may provide in-depth information on the impact and importance of the evolution of miRNAs.

代表圖及中英文說明：



The homologous miR-193a/b precursor sequences from different species and the phylogenic tree.

本圖顯示調控ATP合成酶次單體基因的微RNA miR-193a/b前驅物在不同物種的演化關係。

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Bioinformatics Lab.

本研究室的研究方向為生物資訊與基因演算法。現有醫學、分子生物學、植物學、植物病理、資訊科學、電子電機工程、等，多種背景的學生、研究人員及國內外學者，進行常態性的跨領域合作。目前正進行的研究題目包括-蛋白質交互作用網絡的架構、預測與分析，基因交互作用網絡的架構、預測與分析，第二代定序技術之序列重組、註記與量化分析等。

透過基因變異的比對、蛋白質與基因交互作用的定性資料、基因晶片的定量資料、以及目前日益普及的第二代定序技術所生產的大量序列片段，我們期望了解遺傳疾病、癌症、精神疾病等的致病機制，協助疾病的診斷、預防和治療。同樣的研究方法也應用在其它物種的研究工作上，藉此探究植物的抗（生物與非生物）壓力機制，以及植物與病菌間的蛋白質交互作用，協助開發抗壓抗病高產量高品質的農產品。除此之外，我們也分析大腸桿菌與酵母菌等重要模式物種的基因功能與生化路徑，辨識基因間或蛋白質間的交互作用，進一步推論其它物種的運作模式。許多植物與藻類均為重要的能源作物，可用於生產生質酒精或柴油等，目前的第二代定序技術除可用於模式物種外，針對於非模式物種也進行大量的解序與基因表現分析，龐大且複雜的序列資料讓這個高通量的技術無法徹底發揮潛能，特別是目前可用的資料處理工具甚為匱乏，本研究室除了分析此類資料外，亦開發相關工具和創新的演算法，提升此類資料處理的效率和準確度。

The research focuses of this laboratory are bioinformatics and Taiwanese research. In bioinformatics, our lab apply genetic algorithm and combinatorial optimization to biological problems, solving problems from microarray analysis, protein structure prediction, protein-protein interaction prediction, drug discovery and design, and virtual screening of drug leads. These diverse topics can also be combined into systems biology, study biological problems from a global view. We also tried to translate our researches into applications in clinical medicine and drug developments. In Taiwanese research, we have devoted to the computational linguistics of Taiwanese, including input (optical character recognition) and output (Taiwanese voice synthesis). In the future, we would like to incorporate other elements, and construct a more integrative Taiwanese-computer environment, and facilitate the education of mother tone and archival research.

主要研究領域 Major Research Areas

生物資訊、計算分子生物學、基因演算法

Bioinformatics, Computational Molecular Biology, GA- Based Computing Technologies

研究計畫 Research Projects

計畫名稱：植物，真菌與微生物系統生物學分析工具與資料庫整合分析平台開發架設

補助單位：行政院國家科學委員會

計畫期間：2010/08/01-2012/07/31

研究主要目的是整合microarray和蛋白質交互作用資料，針對的物種是模式植物阿拉伯芥，以及能將植物纖維糖化為五碳糖或六碳糖的真菌與細菌。為了達到研究目標，第一步將開發一個分析工具，暫名PrAccessFinder-讓我們輸入已經分群處理過的microarray資料，點選分群樹上某一節點，節點之下的探針（probe）序列會自動轉成GenBank ID，最終輸出這些基因所對應的蛋白質之間的交互作用網絡圖，網絡圖上每個蛋白質或每筆PPI 的重要性可使用本工具計算。第二步將建立一個阿拉伯芥系統生物學分析平台，暫名為At-omics-使用PrAccessFinder將阿拉伯芥的microarray 資料和PPI網絡圖連結分析；並匯整KEGG pathway資料庫等，製作顯示基因表現變化與時間軸的pathway影片；也將自動化計算挑選microarray資料中，不同實驗條件下表現模式類似的基因。第三步會建立一個纖維水解資料整合分析平台，暫名為CelluKnow，分析細菌或真菌與植物纖維代謝有關的microarray資料，尋找基因表現受到cellulose影響或表現模式與cellulase接近的基因；依照KEGG pathway圖示基因表現的相對變化模式；也將計算每個基因和每筆PPI 的重要性，辨識出與cellulose代謝顯著相關的核心基因。核心基因將依序列相近度，對照到重要纖維水解研究中的物種如Xanthomonas spp.和Trichoderma spp.。本研究對microarray 和PPI 的分析，植物，真菌和微生物的系統生物學，以及纖維酒精的研究有所貢獻。

Project title: Developing bioinformatics tools and on-line platforms for analyzing systems biology databases of plants, fungi, and microbes
Supported by: National Science Council
Project period: 2010/08/01-2012/07/31

The objective of this project is to integrate the microarray and protein-protein interaction (PPI) databases, focusing on the organisms such as the model plant Arabidopsis thaliana, and fungi and microorganisms which are able to convert plant cellulose into pentose or glucose. To achieve our objective, firstly, we will develop an analytical tool, designated "PrAccessFinder", which allow us to input a clustered tree of gene expression patterns from microarray, choose a cluster of probes to be convert into GenBank IDs by clicking on node of the tree, and output a PPI network of proteins encoded by the genes in the cluster. The tool will also be able to calculate the significance of each protein and PPI. Secondly, we will develop a systems biology research platform, designated "At-omics", to merge Arabidopsis thaliana databases. This platform will employ PrAccessFinder to merge the microarray data of A. thaliana with PPI networks. We will also produce series of film strips showing the changes of gene expression over time on KEGG pathways. The similarities of gene expression patterns across various experimental conditions, as assayed by microarrays, will also be compared. Lastly, we will develop a systems biology research platform for the cellulase-producing fungi and microorganisms, designated "CelluKnow". We will identify gene expression patterns which are affected by cellulose and genes which are co-regulated with cellulases in microarray data. The gene expression patterns will be illustrated based on the KEGG pathways. The PPI networks and significance of each gene and PPI will be calculated to discover the "core-genes" which are most relevant to the cellulose metabolism in the organisms. Sequences similar to the above "core-genes" will be identified in Xanthomonas spp. and Trichoderma spp., which are important organisms in the study of cellulases. This project will contribute significantly to analyses of microarray and PPI databases, the systems biology of plants, fungi and microorganims, as well as the development of cellulosic ethanol industry.

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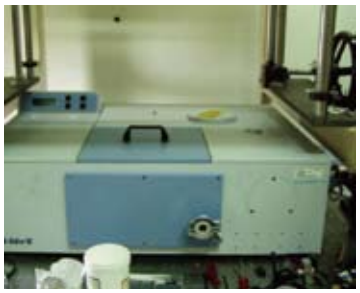
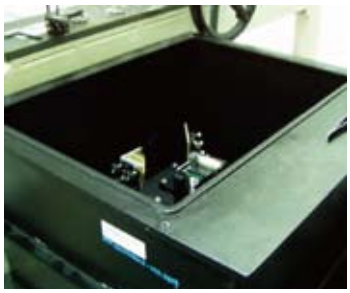
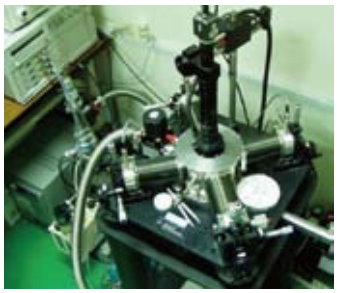
紅外線暨生醫奈米元件實驗室
Infrared and Bio-Chemical Nano-Device Lab.

- 電子束直寫顯影實驗室、電子束掃瞄及顯影實驗室
  (Direct-Writing Electron Beam Lithography System Lab., Scanning Electron Microscope Lab.)
- 微拉曼/光激發光 光譜實驗室 (Micro-Raman/PL Spectral Lab.)
- 紅外線光譜實驗室 (Infrared Spectral Lab.)

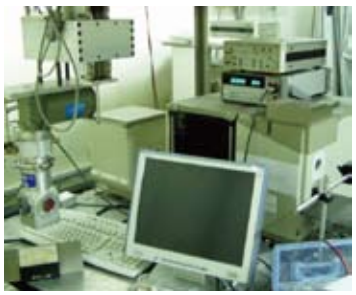




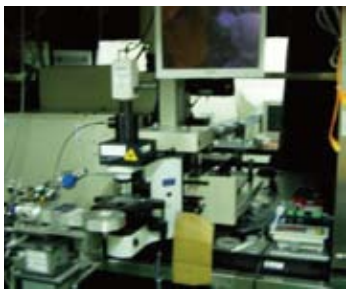
Bruker FTIR 紅外線光譜儀及變角度反射模組



電晶體特性曲線實驗器



FTIR 紅外線光譜儀



T 64000微光譜量測系統
（今年新增XY平面定位掃瞄功能）

電子束微顯影系統

主要研究領域 Major Research Areas

光電元件、雜訊量測、奈米電子、生醫晶片、拉曼光譜分析、利用拉曼光譜做極稀薄分子之光學檢測
Optoelectronic Device, Noise Measurement, Nano-Electronics, Bio-medical Chip, Raman Spectral Analysis, Optical Detection of Ultra-Rare DNA by Raman

研究計畫 Research Projects

1. 矽鍺量子點奈米級記憶元件及陣列之製作與研究
   Nano-scale SiGe quantum-dot memory and array
2. 可低偏高溫操作且正向頂面入射的超晶格紅外線偵測器及陣列的研發
   Development of the Superlattice Infrared Photodetector and Array for Low-Bias High-Temperature Operation and Top Normal Incidence of Light
3. 光譜與電性量測於基因篩選之應用
   Application of spectrum and electrical signal measurements on gene screening
4. 窄頻紅外線光源與偵測器及其在植物與神經細胞上的應用
5. 離子的高敏感度交流電性量測並以紅外線頻譜作輔助分析(2/3)
   High-sensitivity AC electrical signal measurement and infrared spectrum assistant analysis originated from ions
6. 整合雙能障超晶格及量子井紅外線偵測器以達到高偵測率高響應及高溫操作
   Integration of double-barrier superlattice and quantum well infrared photodetectors for advantages of high detectivity, high responsivity,and high-temperature operation

計畫名稱：整合雙能障超晶格及量子井紅外線偵測器以達到高偵測率高響應及高溫操作
補助單位：行政院國家科學委員會
計畫期間：2010/08/01-2011/10/31

在過去的幾十年，利用量子結構紅外線偵測器所製成的大型焦平面陣列熱影像系統已經展現出許多可應用在軍事，民生與生醫方面的可能。因為熱預算及讀出電路之電容飽和應該被避免的考量上，許多的研究都聚焦在高效率且可以低偏壓及高溫操作之光偵測器焦平面陣列為主。然而，操作在高溫下的量子井紅外線偵測器有一個缺點，就是相當高的暗電流，並且此缺點會使得其在製作熱影像系統時受到限制。在本計畫中，我們的目標就是設計出一個具有較低暗電流與較高光電流，且適合在高溫下操作的紅外線偵測器。

多彩的紅外線超晶格光偵測器利用雙能障及多重量子井結構實現，雙能障用以增加光電子的穿透機率使得光電流增加，量子井被用來當成雜訊濾波器。實驗結果顯示背景操作溫度可以達到110K 其光響應在為12mA/W 在0.3V 時。相關的偵測率為2*109 cm Hz0.5/W 當操作溫度為110K 及在 8.4μm (0.3V).8.4μm 及10μm 的光響應在20-80K 是可以可以互換的隨著偏壓的改變.除此之外這個偵測器還有些許的溫度依存關係.這個偵測器非常適合焦平面之畫素選擇

關鍵字：紅外線偵測器，超晶格，光響應增強

Project title: Multi-color Double-barrier Superlattice infrared photodetector combined with quantum well infrared photodetector for operation at high temperature and low bias

Supported by: National Science Council
Project period: 2010/08/01-2011/10/31

The large scale focal plane array (FPA) imaging systems based on quantum well infrared photodetectors (QWIPs) have shown the potential use for military, medical and civil applications. However, the drawback of QWIPs under high temperature operation is the high dark current. In this research, the aim is to design the superlattice infrared photodetectors (SLIPs) which are suitable for high temperature (80 K) and low bias operation with the enhanced photocurrent and the lower dark current.

Multi-color infrared photodetector for operation at high temperature and low bias was realized by a superlattice sandwiched by double barriers with quantum wells (MQWs) are inserted in the right side of them. The BLIP temperature is about 100K and the photoresponse is 12mA/W at 110K under 0.3V. The associated detectivity is 2*109 cm Hz0.5/W at110K and 8.47m under 0.3V.The photoresponse under 20-80K is switchable between 8.47m and 107m by the magnitude of applied bias.In addition, our detector exhibits little temperature dependence of photoresponse at high temperature. This device is the promising candidate of a pixel in the focal plane array.

Keywords:
Infrared Photodetectors , Superlattice, Photoresponse Enhancement

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細胞行為實驗室
Cell Behavior Lab.

細胞行為實驗室主要研究課題，在於瞭解細胞間如何使用物理性因子通訊，並互相調節功能。我們特別對細胞間的機械力和光學訊號傳遞感到興趣。因為相對僅能靠擴散方式作用的化學物質而言，力學和光學訊號的作用範圍更遠，傳遞速度也較快。因此在大範圍組織整合的初始過程，包括組織發育、修補、以及退化，光學和力學訊號可能扮演了具有相當決定性的角色。目前我們研究重點是同質細胞間的自我聚合及功能整合，以及異質細胞間的空間協調，特別是中、外胚層細胞間的分層現象。我們的短期目標是發展出能精確測量、並調控細胞間力學與光學通訊的實驗平台。遠程目標則是促進吾人對異質細胞間在各種生理、病理狀態下的交互作用，並對組織老化及再生的治療方針上有所啓益。

The primary interest of the cell behavior lab is to investigate cell-cell communication via various biophysical factors. Specifically, we examine how cells regulate each other using mechanical and optical signals. Compared with biochemical agents that are primarily transmitted through diffusion, mechanical and optical signals are relatively long-ranged and transmitted at a faster time scale. Hence these signals may play a deterministic role in the initiation of tissue organization at a large spatial scale such as tissue development, regeneration, and degeneration. Currently we are studying the self-aggregation and integration of homogenous cells, as well as the spatial coordination of a complicated cellular network composed of heterogeneous cells, specifically the stratification between mesenchymal and epidermal cells. Current cell model involves muscle, dermal, and endothelial cells. Our short term goal is to develop a novel platform that can detect and modulate the mechanical and optical cues communicated between cells. The long term goal is to improve our understanding in cellular interactions of heterogeneous cells in various physiological and pathological conditions, and shed light on the therapeutic strategy in tissue regeneration and degeneration.

主要研究領域 Major Research Areas

細胞交互行為、組織型態學、醫用生物物理、復健工程、組織工程

Cell-cell interactions, tissue morphogenesis, medical biophysics, rehabilitation engineering

研究計畫 Research Projects

1. (NSC 99-2320-B-002-002)肌肉細胞間機械力通訊對細胞結構及行為之影響
   Effects of cell-cell mechanical crosstalk on the structure and behaviors of muscle cells
2. (NSC 99-2220-E-002-040)智慧型非侵入陣列式血流監控系統晶片--子計畫六：以非侵入陣列式系統晶片監控頸動脈血流動力—力學模型及臨床評估
   Access hemodynamics of carotid arteries using a non-invasively array-based SOC — Mechanical modeling and clinical applications

計畫名稱：肌肉細胞間機械力通訊對細胞結構及行為之影響
補助單位：行政院國家科學委員會

一般認為肌肉細胞間的機械力訊息交換，在肌肉組織的整體結構、個別細胞型態表現，以及細胞之間的行為協調方面，扮演著極重要的角色。然而囿於實驗技術，科學界對肌肉細胞之間，如何以機械力訊息來互相調節結構及行為，仍所知有限。我們計畫發展一新穎的實驗系統，以研究機械力訊息交換對橫紋肌肉細胞型態學、及行為表現的影響。該系統將由二至數個未直接相連的肌肉細胞組成，並以微圖案技術控制個別細胞的初始型態、相對位置、細胞軸向等。同時以特殊方法阻斷或加強細胞之間的力學訊息交換。此外我們還將利用雷射光化學反應來激發選定細胞的自發性收縮，並據以調整其收縮頻率。我們將分析在各種機械力學條件下，細胞間機械力訊號對特定細胞動態學的影響，包括細胞遷移、細胞結構及型態重組、鈣離子波的傳遞、細胞自發性收縮的時域特徵、以及多細胞的整體性行為表現，例如循特定方位的細胞凝集、多細胞間細胞骨骼的重組耦合、以及多細胞同步收縮等。我們並將配合分子生物方法，研究細胞間力學通訊如何調節肌肉細胞的電生理活動。我們也將探討在各種拓樸環境條件下，例如改變相近細胞個數、細胞相對位置、細胞相對軸向，以及三度空間環境等，對上述細胞動態學的影響。本實驗系統初期將針對橫紋肌肉細胞研究，之後研究對象將拓展至異種細胞間的機械力相互作用，例如腫瘤細胞與纖維母細胞，內皮細胞與平滑肌肉細胞等。最後，我們將發展數學模型來解釋實驗結果，並推測機械力通訊調節細胞行為表現的生物物理機轉。本三年計畫的完成，將發展出一套專門探討肌肉細胞間機械力通訊如何影響細胞型態、以及電生理活動的特殊實驗技術與系統。我們相信這些實驗成果，將促進其他針對細胞間通訊如何影響生物型態、生物頻率等方面的基礎研究，包括瞭解在生理及病理狀態下，生物組織、器官、系統的發展過程，以及幹細胞的分化研究等。

Project title: Effects of cell-cell mechanical crosstalk on the structure and behaviors of muscle cells

Supported by: National Science Council

Cell-cell mechanical communication is proposed to intimately regulate the structure and electrical behaviors of muscle cells. Our understanding in this regard however is severely limited by the technical challenging in single cell experiments. In this project we propose to develop an in vitro system to investigate the effects of intercellular mechanical crosstalk on the structure and behaviors of striated muscle cells. The system will allow manual removal and reestablishment of mechanical continuities between the cells, tuning of substrate stiffness, and controllable adjustment of the intercellular distance. Experiments are conducted on pairs of mechanically isolated cells as well as multi-cellular networks. The electrical response of a single cell resulting from mechanical cues derived from neighboring cells will be also investigated. We will initially focus our cell model on striated muscle cells. Later, the effects of mechanical interaction on heterogeneous cell culture, such as cancer cells and fibroblasts, endothelial cells and smooth muscle cells, will also be probed. Finally, we will develop a mathematical framework that can quantitatively explain the experimental observations and propose physical mechanisms underlying tissue morphogenesis in the physiological and pathological conditions.

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Biomedical Signal Lab.

生物醫學信號實驗室隸屬生醫電資所電子組，以復健科技與生物醫學信號分析為主要的研究範疇。本實驗室常年與大型醫療院所保持密切合作，並合力執行多項獲國科會高度正面評價與積極補助之跨領域整合型計劃。本實驗室將電子資訊技術引進至醫學輔具之研發中，進行電子醫學輔具之研究，並屢有佳作。本實驗室現已自行研發成功可商業化生產之肌肉功能性電刺激器，另致力於神經功能性電刺激器的研究，用於控制大鼠泌尿系統，以探討哺乳類動物泌尿控制機制。

另本實驗室在健康照護機制與系統的研究上，進行可應用於復健醫學、預防醫學、家庭醫學、急救醫學、神經醫學等方面之遠距照護系統，本實驗室於數年前即已體認到虛擬實境技術之引進將在電子醫學領域中帶來相當程度的革新。故而本實驗室早已著力於虛擬實境介面技術之開發，本實驗室除進行生物體未知信號之分析與研究，望對現代醫學診斷與分析上提供技術層面的協助外，並以人本為基石，以開發輕便、簡單、低成本的電子醫學輔具為目標。

Biomedical Signal Lab focuses on rehabilitation assistance and analysis of biomedical signals. Our lab has cooperated with medical research institutes closely for several years. In last decade, our lab had implemented the commercial functional electrical stimulation (FES) system which was proved too. With our designed muscular FES system, the paraplegics or hemiplegics with serious disabilities have greatly progressed in their activity in daily life. In addition, we are also devoted to researches of FES applications in urinary incontinence by conducting animal experiments for solutions of mammalian neurogenic detrusor overactivity.

Our lab also studies health-care mechanism and system applied in rehabilitation medicine, preventive medicine, and emergency medicine. Our lab had been aware of the potential of virtual reality applied in rehabilitation, and an innovated rehabilitation assistance combined with virtual game was developed successfully for frozen shoulder patients in past years. In biomedical signals processing and analyzing, our laboratory has made great progress. Our mission statements include not only focusing on techniques helps for modern medical diagnoses and analyses, but also keeping developing simple, easy to use, low cost electrical medical assistances.

主要研究領域 Major Research Areas

生理信號之量測與處理、以數位信號處理器為基礎之醫療儀器、復健科技輔具研發、健康照護系統

Bio-medical signal acquisition and processing, Medical instruments based on Digital Signal Processor (DSP), Technical rehabilitation assistance, Health-care system

研究計畫 Research Projects

1. 老人居家健康照護之心靈互動夥伴(healing partner)系統
   Healing Partner System for the Elderly Healthcare at Home
2. 會陰神經電刺激用於調控大白鼠排尿功能
   Modulation of voiding function by electrical stimulation of pudendal nerves in the rat

計畫名稱：老人居家健康照護之心靈互動夥伴(healing partner)系統 (III)
補助單位：行政院國家科學委員會

面對老人易出現記憶力退化，慢性病與慢性功能障礙的出現率上升等醫療相關議題，本計劃團隊認為老人居家健康照護的重點包括如何對其日常生活中的健康提供協助居家照護的功能: 例如跌倒防治；提醒老年慢性病患須定時且正確服用藥品；協助排除老年人因慢性病痛或長期壓力而造成的失眠；或監測到睡眠時血氧若低於警戒值，則立即啓動緊急通報醫療體系或通知其家人，並注意睡眠障礙、姿勢性低血壓、發燒與早晨起床後的中風等危險。既為排解老人寂寞，同時提供完善的老人健康照護系統。本計劃針對

(1) 床旁陪伴
(2) 用藥提醒
(3) 睡眠監測
(4) 生理監測

等等老人心靈與生理方面之居家健康照護需求，建立一套功能簡便、易於操控、低成本的老人居家健康照護之心靈互動夥伴系統。此系統將整合多種生理感測器(體溫、 血壓、血氧等) 、可攜式小尺寸顯示器、下床偵測裝置、取藥偵測開關；且擁有危險分級分類制度與通報機制。將根據生理參數異常程度、正確準時用藥與否、有無下床逾時不回或自行呼救等因素來進行危險分級分類，根據不同危險級數，決定是否立即透過網路端的監控台通報醫護人員與老人家屬去電關切、前往探視或進行救護行動。本系統尚可依照個人需求進行客製化修改，透過與虛擬家人親友影像的互動，藉由聽、視、及動作來增加老人對感官的刺激，並維持老人腦部的敏感及警覺度，改善社區老人的憂鬱程度，使其擁有良好的生活品質，以及更為健康快樂的人生觀。

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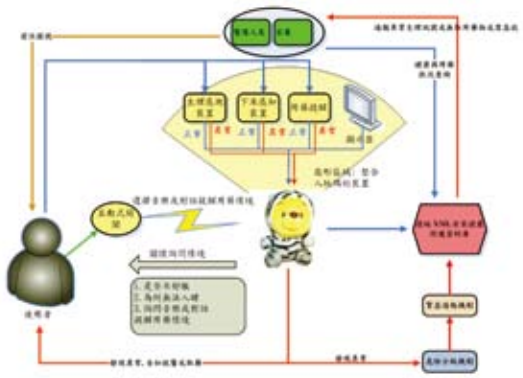
Project title: Healing Partner System for the Elderly Healthcare at Home (III)
Supported by: National Science Council

The elderly often suffer from impaired memory, degenerative diseases, and multiple dysfunction in their daily living. This project proposes the practical solution for these healthcare issues for the elderly at home. These healthcare issues include the prevention of falling in night, the reminding for taking medicine correctly on time, the assistance for alleviating insomnia, the monitoring for vital signs such as blood pressure, body temperature, and blood oxygen saturation at the appropriate time , the connection & activation of the emergency alert system for immediate attention or rescue. That means a user-friendly healing partner system can help the elderly reducing these risks of emotional disturbance, inappropriate medication, sleep disorder, postural hypotension, fever, and fall after waking up, etc. This project is developing a user-friendly healing partner system to provide the following healthcare functions at home for the elderly which includes

(1) the psycho-emotional partner near the bed,
(2) the reminders for taking medicine correctly on time,
(3) the detection for sleep disorders (insomnia and sleep apnea),
(4) the monitoring for vital signs (body temperature, blood pressure, & arterial oxygen saturation).

Depending upon the severity and urgency of alert classification it will be connected to the emergency alert system for informing the medical staff and/or the family to pay attention and/or rescue the elderly if abnormal vital signs, fall, or life threatening situation detected by the system. The system can be customized for different individuals. The system also provides virtual characters with family looks and speeches to interact with the elderly. The interactions, like listening, seeing, and acting, may augment and excite the sensitiveness and alertness of the elderly. By the above-mentioned healthcare at home, this system may release the emotional disturbance such as loneliness, tension, anxiety, & depression, improve the social life, raise the life quality, and bring more benefit for the elderly, too.



< 1> The illustrations of the healing partner system

本圖顯示為老人居家健康照護之心靈互動夥伴系統。為老人日常生活中的健康提供協助居家照護的功能。

The foregoing figures illustrate a tailored healing partner system that provides practical solution for common healthcare issues for the elderly at home.

賴飛羆 教授 *Lai, Fei-pei,* Professor

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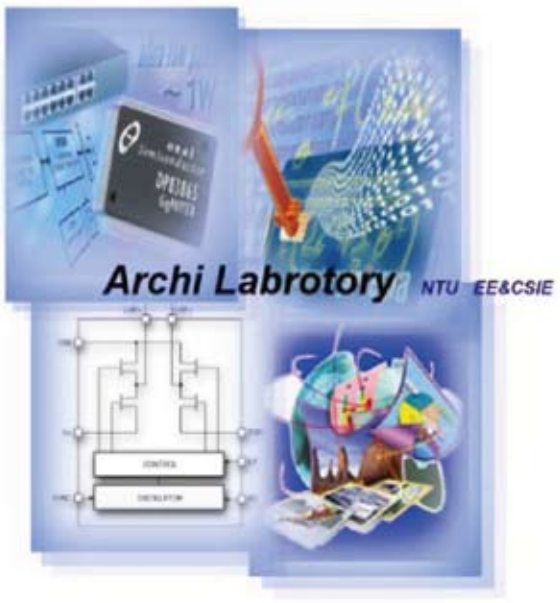
醫學資訊實驗室
Medical Informatics Lab.

本實驗室成立於1987年，由 賴飛羆教授所領導的研究群組成。實驗室成員包括博士班和碩士班研究生28名。本實驗室研究領域廣泛，實驗室創立初期以研究「計算機結構」，「低功率系統晶片設計」為主，近年來改以 醫學資訊為主要目標，本實驗室的研究方向包含：

1. 電腦與通訊網路安全機制研究
2. 醫學資訊

This Lab. was established in 1987 and Professor Feipei Lai works together with 13 Ph.D. students and 15 master students. The major research areas include Security, and Medical Informatics. Our Lab. has cooperated with numerous IT companies and other overseas universities including Dortmund University in Germany, Calgary University in Canada and Mongolian University of Science and Technology in Mongolia.

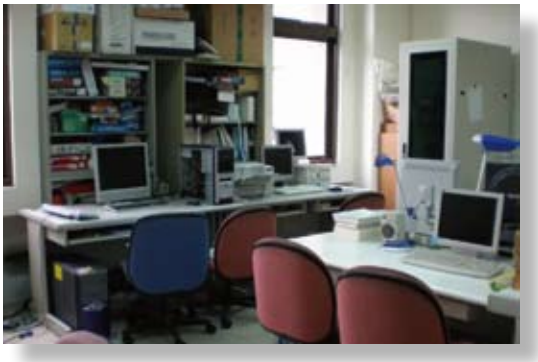


主要研究領域 Major Research Areas

資訊安全、醫學資訊
Information Security, Medical Informatics

研究計畫 Research Projects

1. 自動化低功率及低漏電流 內容可定址記憶體 產生並模擬及驗證工具集(2009/08/01-2012/07/31)
   An automatic tool set for generating, simulating and verifying low power and low leakage content addressable memory
2. 開放式知識探勘平臺 (2009/08/01-2012/07/31)
   Sharable Knowledge Mining Platform
3. 醫療資訊探勘 (2009/08/01-2012/07/31)
   Data Mining on Healthcare



計畫名稱： 開放式知識探勘平臺
補助單位： 行政院國家科學委員會
計畫期間： 2009/08/01-2012/07/31

醫療資訊系統的價值在於協助醫護人員用較快速度及較少的成本處理醫療事務，可讓組織有效率的運作發揮組織最大的功能，造福更多病患；隨著資訊系統長期運作，在系統背後累積大量的電腦化數據，如能進一步進行資料探勘，則可將原始資料(Data)轉化成有用的知識(Knowledge)，產生更大的附加價值；例如分析醫令順序以及檢驗、檢查內容可以探勘出臨床路徑(Clinical pathway)及臨床指引(Clinical guideline)，如此能進一步提升醫療品質及降低醫療成本。如能採用醫療資訊相關標準進行研究平台的建立，則研究成果可分享給其他的醫療機構應用。就台大醫院而言，其醫療案例既多且廣，已具初步資料探勘所需資料，且台大醫院之醫療資訊系統遵循HL7、DICOM、ICD 等國際標準，若能以此資料庫及標準化的系統為基礎建立研究平台，並將研究成果以標準化的方式表示，則能將此成果分享給其他醫療機構。另一方面，其他醫療機構之資料也能經標準化的格式傳輸至此研究平台，使用平台上的資料探勘、知識發現等模組。

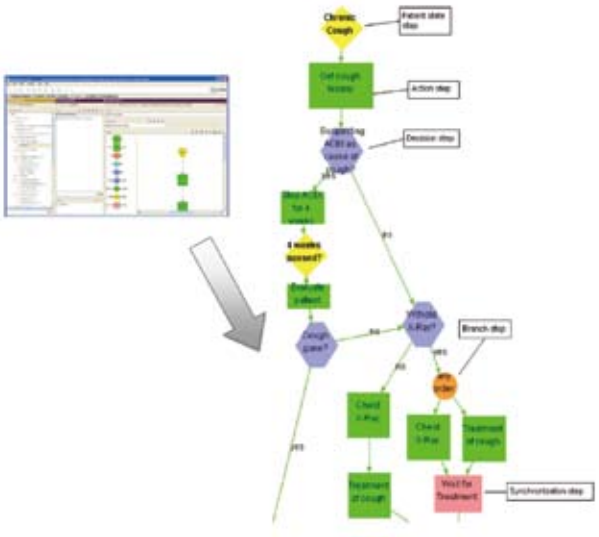
關鍵詞：醫療資訊系統、資料探勘、知識發現、臨床路徑、臨床指引

Project title: Sharable Knowledge Mining Platform
Supported by: National Science Council
Project period: 2009/08/01-2012/07/31

The basic value of health information systems is to support medical related workers to deal with their jobs more quickly and with less cost. Then, the health information systems can let organization operate more efficiently and get its best efficiency. Finally, the systems can bring a great benefit to patients. With the operation of the information system for a long time, there is a great amount of computerized data stored in the system. After doing data mining focused on these data, we can extract knowledge from these databases and bring more and more additional value. For example, if we analyze the sequence of the medical orders and the content of the laboratory and observation and we can extract the knowledge about the clinical

pathway and clinical guideline. Therefore, we can improve the quality of the health care and reduce the cost. If the research platform is built based on medical related standards, then the research results can be shared to other medical related institutions. There are numerous and various cases in the NTUH (Nation Taiwan University Hospital), and the database contains the needed data used by data mining. Besides, the health information system in NTUH follows many international standards such as HL7, DICOM and ICD. If we can build the research platform based on the database and the standardized systems, then we can share the study results to other medical institutions. On the other hand, other medical institutions can upload their data to the platform through many standardized format of transmission, and then they can use the module of data mining and knowledge discovery in the platform.

代表圖及中英文說明：



使用Protégé 編輯由GLIF3 所表示之慢性咳嗽之臨床指引

Keywords: health information system, data mining, knowledge discovery, clinical pathway, clinical guideline

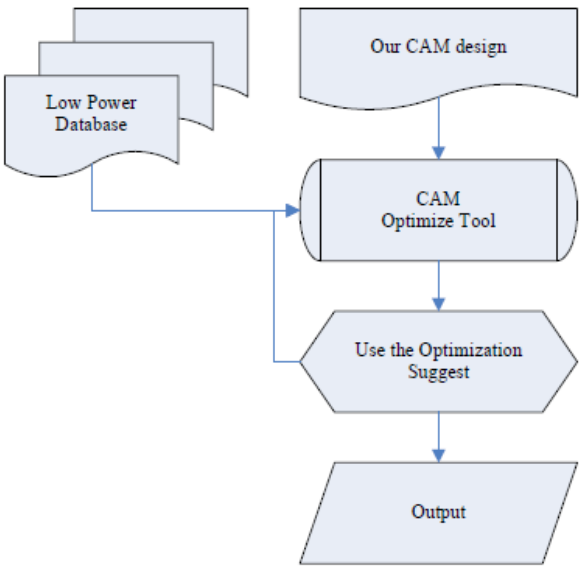
計畫名稱：自動化低功率及低漏電流內容可定址記憶體產生並模擬及驗證工具集
補助單位：行政院國家科學委員會
計畫期間：2009/08/01-2012/07/31

由於內容定址記憶體為因應現在網路技術要求而日益龐大，導致相關模擬軟體所需消耗時間越來越多。且因製程技術進步，臨界物理極限導致元件漏電流效應益發嚴重，為了解決這個問題，並有效推斷漏電流所帶來的功率消耗影響，我們的計畫中提出如何在相對精準的情況之下，能夠快速的對內容定址記憶體做出初步模擬，來達到設計快速驗證的目標。在這三年的計畫，我們主要研究課題有三個方面：(1)利用 SystemC 去實作內容定址記憶體的高階模擬軟體，用意主要在快速初步模擬出對整體架構的效能與可行性評估、功率消耗評估以及使用SystemC 做出模組自動合成軟體。(2)提出一個完整的電路程式碼合成軟體可用來產生內容定址記憶體相關進一步精確模擬中所需所有的程式碼，如 SPICE 程式碼、測試參數等等。在自動合成出的程式碼當中，拿去做更精確的驗證模擬。並在此時解決製程先進所帶來的漏電流問題。(3)提出一套可自動去驗證出電路中會產生的各種寄生效應的軟體，用此軟體去評估我們所設計的 CAM 架構所會產生的寄生性的電容、電感、電組的相關效應，並將這些參數輸入 Cell Library 當中，以達到在初步驗證模擬時，即可藉由 Cell Library 當中的模組得知其相關效應。

Project title: An automatic tool set for generating, simulating and verifying low power and low leakage content addressable memory
Supported by: National Science Council
Project period: 2009/08/01-2012/07/31

In the generation of modern network, people need more complex technology of content addressable memories to solve the problem of network transmission. Therefore, the architecture of content addressable memories operates at higher frequency and the number of transistors increases very hugely and the time designers spend to simulate becomes longer and longer. As a result of process technology upgraded, devices leakage current become more serious. In order to reduce the simulation time, and estimate the effect of leakage, which brought about to the impact of power consumption, we need to produce a kind of software able to reach a goal of fast simulation with reasonable accuracy. Our researches focus on three main topics in three years. First, we will design a kind of high level simulation software that can fast simulate the performance, the reliability, the power dissipation of CAM architectures with reasonable accuracy and to produce a model of auto-composed software with SystemC. Second, we will do research on a complete circuit source-code generation software, such as SPICE code, testing parameter, etc in order to produce all needed software codes in the CAM simulation. Moreover, we take these auto-composed source codes to simulate with high accuracy. Then we will propose some methods to solve the problem of leakage current. Third, we will do research on a kind of software which is able to calculate all the effects in layout and make use of these data to create the cell-library models. Therefore, we will know these efforts of post-simulation in the initial circuit simulation.

代表圖及中英文說明：

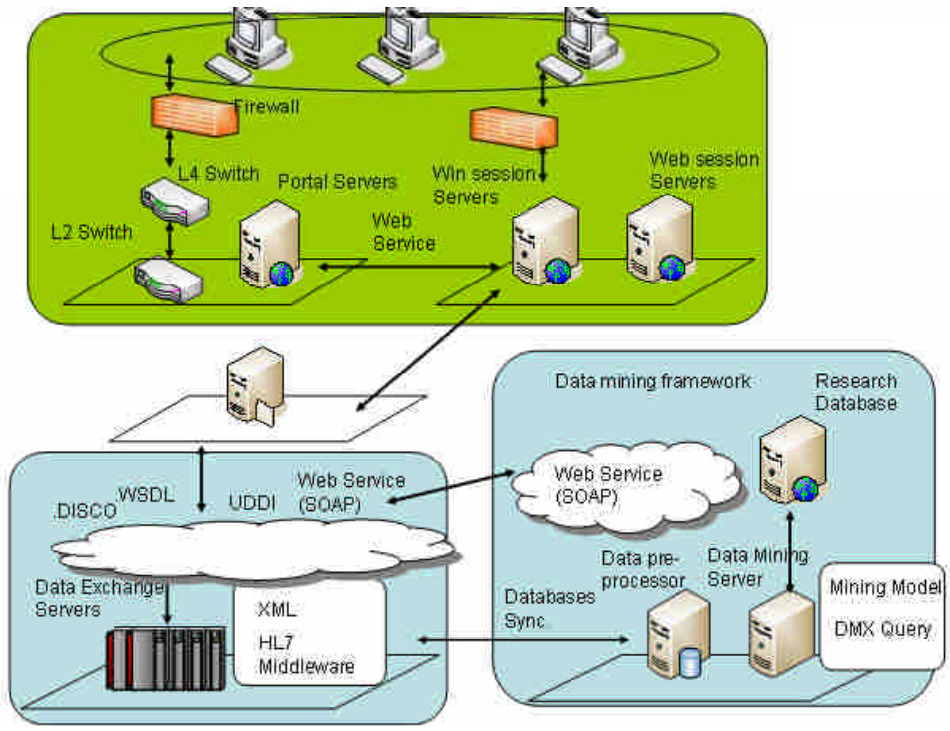


架構最佳化流程

計畫名稱： 醫療資訊探勘
補助單位：行政院國家科學委員會
計畫期間： 2009/08/01-2012/07/31

隨著醫療水準的提升，全球逐漸邁入老年化人力結構，如何提高醫療資源運用效率---提高治癒率及降低醫療成本成為國內外醫院努力的目標。而這兩個目標可以從疾病的早期發現、標準化的治療流程著手。故近年各家醫院無不投入大量的人力物力進行臨床路徑規劃、臨床指引的設計及各項檢驗數據的判讀。在醫療資訊系統累積大量的電腦化數據，如能進一步進行資料探勘，則可將原始資料 (Data)轉化成有用的知識 (Knowledge)，產生更大的附加價值；例如分析醫令順序以及檢驗、檢查內容可以探勘出臨床路徑 (Clinical pathway)及臨床指引(Clinical guideline)，如此能進一步提高治癒率及降低醫療成本。每個國家因為地理位置、氣候、種族、生活習慣、飲食文化、社會型態不一，故易罹患的疾病及治療的方法不同，但人工智慧模型貴於可從資料學習背後代表的意義，從不同的資料可學習出不同的知識；學理上可跨越醫院、國家、種族等藩籬，此次能有機會與蒙古國共同進行此研究計畫，除了促進國際學術合作外，亦可驗證此特性，此計畫研究成果有助於將資料探勘等人工智慧模型在醫療系統方面的應用推廣到全世界，以發揮更大的效益。

代表圖及中英文說明：



醫療資料探勘平台系統架構圖

Project title: Data Mining on Healthcare
Supported by: National Science Council
Project period: 2009/08/01-2012/07/31

With the improvement of health care quality, the world is gradually become an aging society. How to improve the efficiency of medical resource utilization, that is, to increase the cure rate and reduce health care costs become the objective of the efforts of hospitals. The two objectives can be achieved by early detection of diseases and standardization of treatment processes. Therefore, in recent years, hospitals have invested a lot of manpower and resources to conduct the clinical pathway planning, design the clinical guidelines and interpretation of diagnosis data. With the operation of the health information systems for a long time, there is a great amount of computerized data stored in the system. After doing data mining focused on these data, we can extract knowledge from these databases and bring more and more additional value. For example, if we analyze the sequence of the medical orders and the content of the laboratory and observation and we can extract the knowledge about the clinical pathway and clinical guideline. Therefore, we can improve the quality of the health care and reduce the cost. Each country as geographical location, climate, race, living habits, diet, culture, social patterns are different, so the disease risks and treatment methods are also different. But the artificial intelligence models can extract the knowledge from the huge raw data. The models can learn different knowledge from different raw data. In theory, the learning models can apply on different hospitals, countries and races. It's great to have this opportunity to work with the academic institution in Mongolia to carry out this joint research project. Not only to promote the international academic cooperation, but also to prove the artificial intelligence models robustness. The results of this project will contribute the artificial intelligence models such as data mining technology in health care applications to the world.

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統計信號處理實驗室
Statistical Signal Processing Lab.

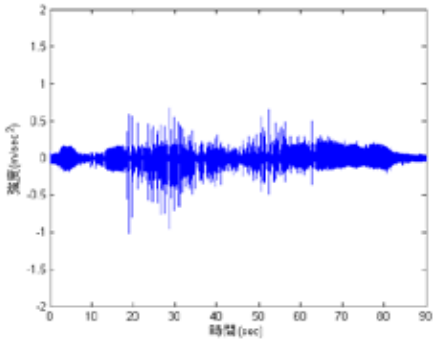
本實驗室由李枝宏教授負責成立於1986年，主要研究領域為數位信號處理之理論與技術研發，近年來也積極進行應用數位信號處理之理論與技術於生醫領域之相關研究：包含(1)由國立臺灣大學醫學院骨科部提供人體膝關節病變與運動傷害所產生之振動訊號，應用相關信號處理理論研發建立此振動訊號之數學模型的技術，以協助臨床上分析診斷人體膝關節病變與運動傷害之型態與種類，以期提供醫生進行正確且必要醫療措施所需之資訊。(2)由國立臺灣大學獸醫學系提供馬匹膝關節病變與老化所產生之振動訊號，應用相關信號處理理論研發建立此振動訊號之數學模型的技術，以協助臨床上分析診斷馬匹膝關節病變與老化之型態與種類，以期提供獸醫生進行正確且必要醫療措施所需之資訊。(3)由國立臺灣大學醫學院牙科部提供人體顳顎關節病變所產生之振動訊號，應用相關信號處理理論研發建立此振動訊號之數學模型的技術，以協助臨床上分析診斷人體顳顎關節病變之型態與種類，以期提供醫生進行正確且必要醫療措施所需之資訊。目前進行的研究希望利用此特性進而更精確的找出膝關節振動訊號的特徵，進而發展實用簡單方便的非侵襲性關節診斷系統。

I. BASIC DIGITAL SIGNAL PROCESSING：
   (1) Techniques for the Design and Implementation of 1-D and 2-D FIR and IIR Digital Filters.
   (2) Techniques for Design and Implementation of 1-D and 2-D FIR and IIR Digital Filter Banks (Multi-rate Digital Signal Processing)

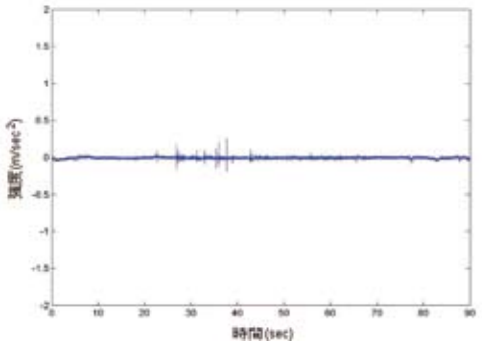
II. STATISTICAL DIGITAL SIGNAL PROCESSING：
   (1) Adaptive Signal Processing for Array Signals
   (2) Adaptive Array Beamforming Under Random Mismatches
   (3) Adaptive Array Bearing Estimation Under Random Mismatches
   (4) Adaptive Beamforming Using 2-D Circular Array for Wireless CDMA Systems
   (5) Adaptive Minimum Bit Error Rate Beamforming Assisted Receiver for Wireless Communications
   (6) Adaptive Signal Processing Techniques for Smart Antennas with Applications in Wireless and Mobile Communications

III. PROCESSING AND ANALYSIS OF BIOMEDICAL SIGNALS ：
   Analysis and Processing of Joint Vibration Signals for the Diagnosis of Cartilage Pathology
   (1) Signal Processing Techniques for Vibration Signals of Human Knee Joints
   (2) Signal Processing Techniques for Vibration Signals of Equine Knee Joints
   (3) Signal Processing Techniques for Vibration Signals of Human emporomandibular joints

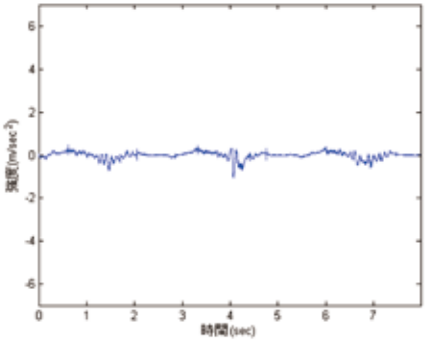
Goal of this research: To conduct research on Vibration Arthrometry (VAM) and provide the public a noninvasive, accurate tool (Expert Systems) for the diagnosis of joint disorders in clinical medicine.



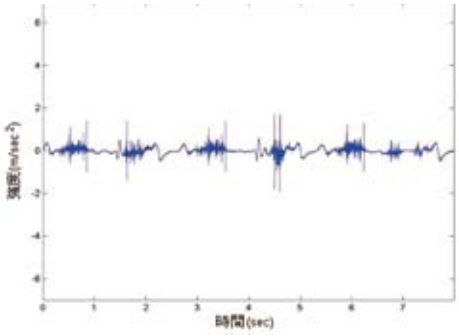
(A) 正常著膝關節在慢速擺動下所產生的振動訊號 (Physiological Patellofemoral Crepitus;PPC)



(B) 非正常著膝關節在慢速擺動下所產生的振動訊號 (Physiological Patellofemoral Crepitus;PPC)



(C) 正常著膝關節在快速擺動下所產生的振動訊號 (Vibration Arthrometry;VAM)



(D) 非正常著膝關節在快速擺動下所產生的振動訊號 (Vibration Arthrometry;VAM)

主要研究領域 Major Research Areas

數位信號處理、智慧型天線與無線通訊信號處理、生醫信號處理、數位影像處理
Digital Signal Processing, Signal Processing for Smart Antennas and Wireless Communications, Biomedical Signal Processing, Digital Image Processing

研究計畫Research Projects

1. 應用於視訊信號處理之二維副頻帶濾波器組之設計
   Design of Two-Dimensional Subband Filter Banks with Applications to Video Signal Processing
2. 應用於通訊環境下可適性陣列信號處理理論與技術之研究
   Theory and Techniques for Adaptive Array Signal Processing Under Communication Environments

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李嗣涔 教授 *Lee, Si-Chen,* Professor

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國立臺灣大學 校長

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National Taiwan University
President, National Taiwan University

薄膜電晶體實驗室
TFT Lab.

薄膜電晶體實驗室（TFT Laboratory）由李嗣涔教授領導，是台灣大學電子工程學研究所奈米電子組（Nano Electronics Group）的實驗室，實驗室的研究方向為：室溫窄頻電漿子紅外線發射器、雷射；多頻道量子點紅外線偵測器；窄頻紅外線照射對植物生長基因表現之研究；孔洞形狀對表面電漿子的異常穿透效應；兆赫等級之量子環偵測器及非晶矽與多晶矽薄膜電晶體的創新製程研究等。本實驗室利用表面電漿效應，首度開發出室溫、窄頻且可調變波長之紅外線發射器，且成功地應用在植物生長基因表現之研究上。在未來，我們將研究窄頻紅外光如何影響癌細胞生長和基因表現。

利用電漿子熱輻射紅外光源之窄頻寬的特性，我們可研究在不同波段下，生物持續受到紅外光照射時，其成長型態、基因表現，以及所有蛋白質的增減變化。主要使用的波段有 3、3.5、4、4.5、5 μm ，其半高寬可達0.5 μm 的窄頻寬，利於未來針對特定波段作進一步研究。

本實驗室研究發現，大腸桿菌進行24小時的紅外光照射後，能測量其菌落在不同紅外光波長下照射的變化。藉由量測菌落直徑，可統計大腸桿菌受不同波段紅外光影響的生長變化，如圖一所示。此外，利用二維電泳分析法，可測量照射紅外光後的大腸桿菌，其蛋白質表現量的變化。當特定波段紅外光促進大腸桿菌生長時，某些膜蛋白質會出現正調控的現象。在肺癌細胞A549接受紅外光照射的研究上，我們發現當照射波長3-5μm紅外光48小時，可影響肺癌細胞A549的成長，和控制組相比會有明顯細胞數量上的差異，細胞直徑則有膨大的現象發生，如圖二細胞計數器的結果所示。

The Thin Film Transistor lab is led by Professor Si-Chen Lee. It belongs to the Nano Electronics Group of the Graduate Institute of Electronics Engineering of National Taiwan University. The research directions of this lab are: the surface plasmonic infrared thermal emitter and laser at room temperature; the multi-color quantum-dot-infrared photodetectors; the effect of narrow band infrared illumination on the expression of the plant genes; the hole shape effect on the extraordinary transmission of the surface plasmon polariton; the quantum-ring infrared photodetectors in the THz range and the new fabrication processes of the a-Si:H and poly-Si thin film transistors.

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Our lab has developed the narrow bandwidth, tunable wavelength and room temperature-operated infrared thermal emitter. It is utilizing the surface Plasmon theory to operate. It has been applied successfully to observe gene expression during the plant growth. In the future, we plan to investigate the growth and gene expression of cancer cell after illuminated by narrow bandwidth infrared radiation.

The narrow bandwidth characteristic of plasmonic thermal emitters is used efficiently to compare growth morphology, gene expression and proteins of organism under different infrared wavelength. There are common wavelengths applied to research, such as 3, 3.5, 4, 4.5 and 5 μm. Their full width half maximum (FWHM) are about 0.5 μm.

Escherichia coli (E. coli) growth morphology is inspected by colony spot diameter and analyzed statistically as shown in Fig. 1. In order to compare proteins expression between experimental group and control group, two-dimensional gel electrophoresis is used after E. coli exposed by infrared radiation or just growing in dark. Recently, we found that while the specific wavelength of infrared radiation can increase E. coli growth rates, some membrane proteins are up-regulation obviously. A549 lung cancer cells are exposed by infrared light wavelength 3-5μm generated by filter for 48 hours. The cell number and diameter are measured by cell counter as shown in Fig.2. We found that A549 lung cancer cells showed hypertrophy and cell number was decreased obviously.

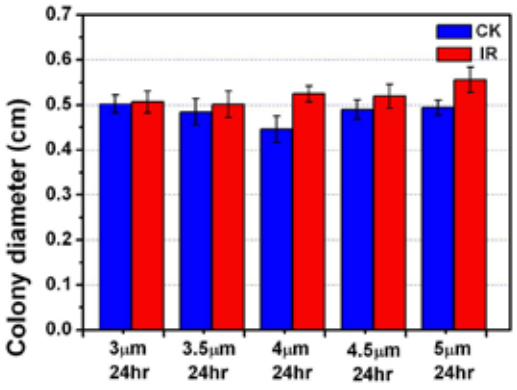

Fig.1 *E.coli* colony diameter chart after infrared exposure

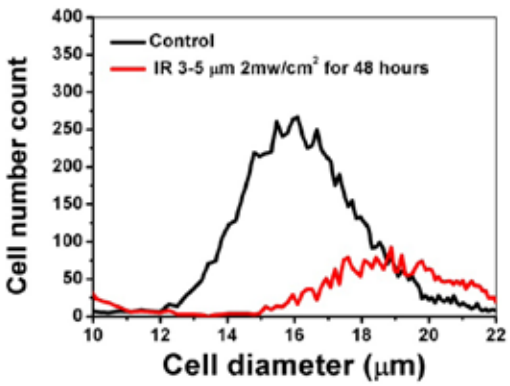

Fig.2 A549 lung cancer cell number and diameter chart

主要研究領域 Major Research Areas

量子點及量子環偵測器、非晶及多晶矽薄膜電晶體、電漿子熱發射器及其在癌細胞、植物生長之應用、太陽電池

Quantum Dot and Quantum Ring Photodetector, Amorphous and Poly-Si Thin Film Transistor, Plasmonic Thermal Emitter and Its Application to Biotechnology and Cancer Cell, Solar Cell

1. 用於電子紙顯示器之軟性能量回收主動式矩陣電路(3/3)
   Flexible Energy-Recycling Active Matrix Circuits for Electronic Paper Display(3/3)
2. 窄頻紅外線光源與偵測器及其在植物與神經細胞上的應用(3/3)
   The narrow bandwidth infrared emitter and detector with applications in plants and neuron cells(3/3)
3. 使用電漿增強型原子層沈積技術製作氧化鋅透明薄膜電晶體
4. 能源國家型科技計畫-計畫辦公室設置與運作計畫
   National Science and Technology Program：Energy Office Administrative Project (2011)
5. 100年度奈米國家型科技計畫：
   1~10 μm窄頻高功率紅外線光源研發及其在矽光子學，生物技術及癌症治療上的應用
   2011 National Science and Technology Program for Nanoscience and Nanotechnology：
   Development of 1~10 μm Narrow-band High Power Infrared Light Source with Applications in Si-photonics, biotechnology and cancer therapy (2011)
6. 利用奈米微結構的高效率可撓式薄膜太陽能電池與異質接面矽晶太陽能電池
   High Efficiency Flexible Thin Film Solar Cells and Heterojunction Solar Cells by utilizing Nano-structure
7. 製成條件對銦鎵鋅氧化物(IGZO)薄膜之影響與分析

計畫名稱：窄頻紅外線光源與偵測器及其在植物與神經細胞上的應用(3/3)
補助單位：行政院國家科學委員會
計畫期間：2009/08/01 - 2011/10/31

近年來，本實驗室應用表面電漿效應的原理，製作出Ag/SiO2/Ag三層結構，可操作在室溫、發出高強度且窄頻的紅外光源，利用改變上層金屬銀孔洞之週期，則可以任意調整熱輻射波長，目前我們已經將這項成果發表並申請專利。此外，我們製作出雙波段及三波段的熱輻射器，並在改變二氧化矽厚度時，發現等效折射率的變化會影響紅外線發射器之波長，從理論上也得到印證。利用紅外光吸收頻譜，可觀察不同無機或有機分子對光的吸收峰位在何處，若我們以窄頻段紅外光去照射生物體，且造成其生長型態或基因表現的差異，那我們就可去推敲，可能是何種無機或有機分子在影響生物體的新陳代謝，進而設計實驗去驗證生化反應的調控路徑。我們同時希望在研究過程裡，能瞭解紅外光是如何影響生物成長，加強其正調控和負調控的反應機制，那麼未來無論是正常細胞修復或是異常細胞治療，都可利用適當(時間、波長、強度)紅外光的照射來達成預期的結果。

大腸桿菌是常見的真核生物，由德國細菌學家Theodor Escherich在1885年發現，因為基因簡單、且已經全部測出，在生物科技和微生物學實驗常被用來做基因複製和基因表現的研究。近年來，我們實驗室也運用大腸桿菌來觀察紅外光對基因和蛋白質表現的影響，我們會先選定欲使用的紅外光波長，運用半導體的製程技術和物理光學的原理，調整表面電漿熱輻射發射器的Ag孔洞週期和排列方式。接著，我們會將照光組定為實驗組，進行24小時的紅外光照射實驗，生長箱環境則控制在溫度37°C和濕度85%。如圖一所示，表面電漿熱輻射發射器的SiO2層都是厚度100nm，上層Ag的厚度100nm，孔洞週期分別為2.3, 2.6, 3, 3.3 and 3.7 μm，藉由FTIR紅外光譜儀的量測，我們可測得紅外光峰值在3.1, 3.5, 3.9, 4.4 and 5.0 μm。圖二為有照紅外光組和未照紅外光組的大腸桿菌的PCR結果，可發現接受紅外光照射的大腸桿菌，相較於未照光組，其上游基因表現會產生差異，可能造成下游各種蛋白質表現量的正調控和負調控。

Project title: The narrow bandwidth infrared emitter and detector with applications in plants and neuron cells(3/3)
Supported by: National Science Council
Project period: 2009/08/01 - 2011/10/31

In recent years, our laboratory has utilized the surface plasma effects to discover the Ag/SiO2/Ag three-layer structure which can be operated in room temperature and generate high power and narrow-band infrared light. By changing the array period of the upper metallic lattice, the peak wavelength can be tunned. We have filed a patent and tried to develop dual-band and three-band thermal radiation devices. We also found that when the thickness of silicon dioxide in the structure is changed, the equivalent refractive index also changes, it will affect the peak wavelength of the infrared radiation. The theory has been developed to verify the experiments. The infrared light absorption spectra are well known for different inorganic or organic molecules. If we illuminate living organisms with narrow-band infrared light , then we can scrutiny the results of growth morphology or gene expression differences. This phenomenon may result from inorganic or organic molecules that affect the metabolism of organisms. We would like to design experiments to verify the path about the regulation of biochemical reactions and understand how infrared light affect organisms growth like increase its positive regulation and negative regulation of the response mechanism. In the future, whether normal cell repair or abnormal cell therapy could use of appropriate (exposure time, wavelength, intensity) infrared light exposure to achieve the desired results.

The German bacteriologist Theodor Escherich discovered Escherichia coli (E. coli) in 1885. E.coli survive for short periods outside the body. Most importantly, E.coli genetics are much simple and manipulated or duplicated easily. In biotechnology and microbiology, E.coli are the famous prokaryotic model organisms. We also use E.coli exposed by infrared light to analyze the expression of its genes and proteins. In the beginning, the specific wavelength of the plasmonic thermal emitter in this experiment is selected. According to the selected wavelength, the lattice constant “a” and the hole diameter “d” of the top silver periodical array could be determined by extraordinary transmission peak formula. The E.coli exposed by infrared radiation is defined as the experimental group. During 24 hours infrared radiation exposure, the temperature and humidity are set at 37℃ and 85% RH, respectively. Ag/SiO2/Ag three-layer structure with the variance of upper metallic holes array constant lattice, it can be a tunable wavelength thermal radiation emitter. The SiO2 layer was deposited by Electron beam evaporation with the thickness of 100nm for all samples. Then a 100 nm-thick Ag film perforated with circular holes arranged in hexagonal lattice constant of 2.3, 2.6, 3, 3.3 and 3.7 μm for samples A, B, C, D, and E, respectively were produced by thermal evaporation on patterned photoresist and lifted-off. Then the emission spectrum and full width at half maximum (FWHM) are measured by Fourier Transform Infrared Spectroscopy (FTIR),and the emission peaks of the plasmonic thermal

emitters are at 3.1, 3.5, 3.9, 4.4 and 5.0 μm, respectively as shown in Fig.1. The Fig.2 shows the PCR results of the control group and experimental group. The experimental group which was treated by infrared radiation reveals some proteins up-regulated. And the functions of these proteins include catalyzing chemical reactions, membrane transport and chemoreceptor, and even synthesis of nucleoside triphosphates. However, comparing the results of experimental group to the control group, there are some proteins represent down-regulated. And two of them (Flavoprotein WrbA and Single-stranded DNA-binding protein) are related to the DNA. These data could help us to understand that the infrared radiation may affect not only the membrane proteins but also the protein expression in the cell.

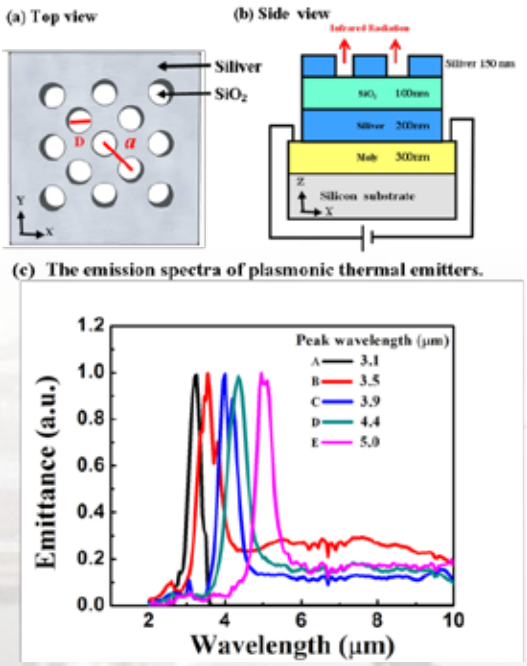

Fig.1
The device we designed to observe the effects of IR on E.coli. The (A) top and (B) side views of the Ag/SiO2/Ag plasmonic thermal emitter. (C) The normalized emission spectra of the five plasmonic thermal emitter lattice samples, A to E. In order to increase the plasmonic thermal emitter temperature, molybdenum was used as a resistance heater. The emission peak wavelengths were 3.1, 3.5, 3.9, 4.4 and 5.0 μm, respectively.

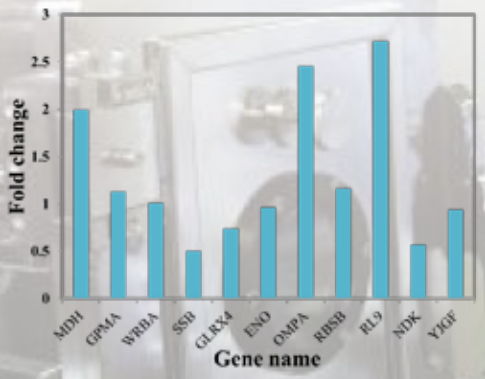

Fig. 2
Confirmation of differential expression is evalued by Real-Time PCR. The fold change is ratio of IR/Control .Yellow grids mean that results of Real-Time PCR and 2D gel electrophoresis analysis are match.

李百祺 特聘教授 *Li, Pai-Chi,* Distinguished Professor

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超音波影像實驗室
Ultrasonic Imaging Lab.

本實驗室由李百祺教授成立於1997年，主要從事醫學電子與影像物理相關研究，目前以生醫超音波技術與光聲影像等領域為研究重點。本實驗室在上述領域已產出許多具體貢獻並在全世界有很高之能見度。此外，本實驗室之成員來自電子、資訊、工程、生命科學及醫學等各領域，多年來亦積極與國內外單位進行合作，合作夥伴包括產、研、學各界，領域更涵蓋基礎科學、工程技術與臨床研究。跨界整合研究資源，致力前瞻生醫科技研究，提升健康與醫療品質，是本實驗室之成立宗旨與具體目標。

Ultrasonic Imaging Laboratory was founded by Professor Pai-Chi Li in 1997, with the main research focus in biomedical electronics and imaging physics. In the past few years, we have conducted a number of research projects in biomedical ultrasound and photoacoustic imaging. We have also made several critical contributions and are now one of the most visible research laboratories in this field in the world. Members of the lab come from various backgrounds, including electronics, informatics, engineering, life sciences and medicine. We have also been actively collaborating with research labs throughout the world, covering industry, research institutes and universities, from basic sciences, engineering to

clinical research. Integrating multi-disciplinary research efforts, exploring advanced biomedical technologies, and improving healthcare quality is the mission of this lab.

主要研究領域 Major Research Areas

生物醫學工程、超音波影像、生醫光聲影像
Biomedical Engineering, Ultrasound Imaging, Biomedical Photoacoustics

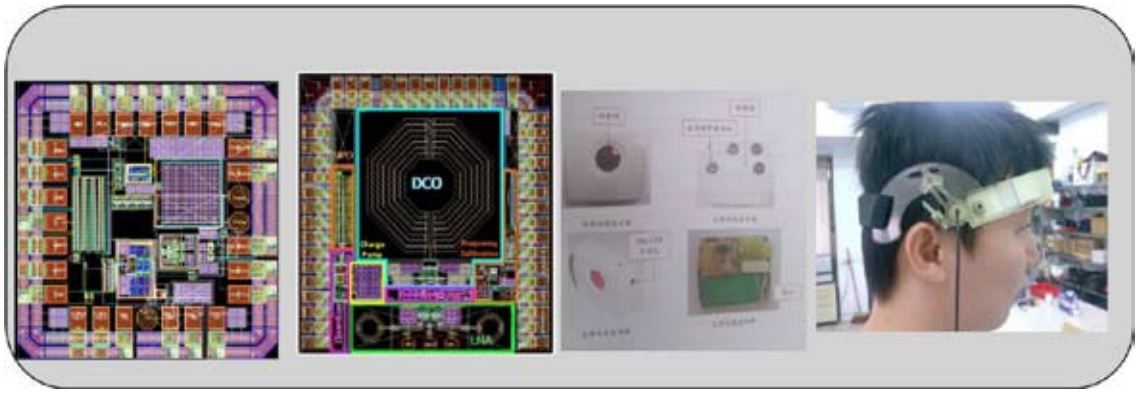
研究計畫 Research Projects

1. 前瞻生醫電子晶片開發與醫療系統整合
   Development of Advanced Biomedical ICs and Integration of Medical Systems
2. 血管內光聲與超音波影像技術開發及超音波輔助血栓溶解之研究
   Development of IVPA/IVUS imaging technologies and investigation on ultrasound-assisted thrombolysis
3. 使用多模式分子影像探針量化研究超音波標靶治療
   Quantitative study of US based targeted therapy: the use of US/PET and US/MRI molecular probes

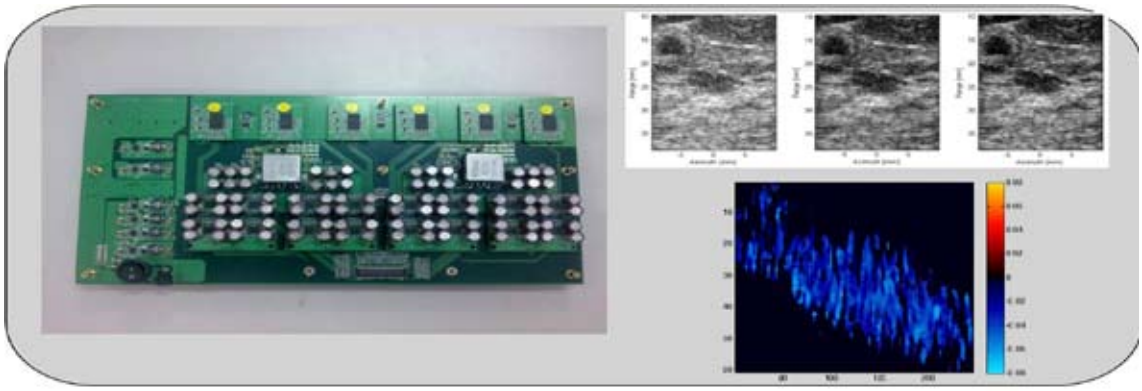
計畫名稱：前瞻生醫電子晶片開發與醫療系統整合三年計畫
補助單位：經濟部
計畫期間：2009/09/01 - 2012/08/31

本計畫以三大目標應用系統為開發載具，分別為「微型無線生理監視儀」、「可攜式超音波影像儀」及「無線神經電刺激器」等。為達成開發目標，本計畫將開發多項關鍵技術，包括低功率無線傳輸、寬頻即時影像傳輸、神經電刺激、可攜式可適性超音波影像技術、低功率DSP引擎、超音波式無線功率傳輸、Cuda高效能運算平台等。此外，除工程技術之研發外，台大醫學院之臨床醫師與生科院之基礎研究教授亦將共同參與，以確保相關技術生醫應用之適切性。

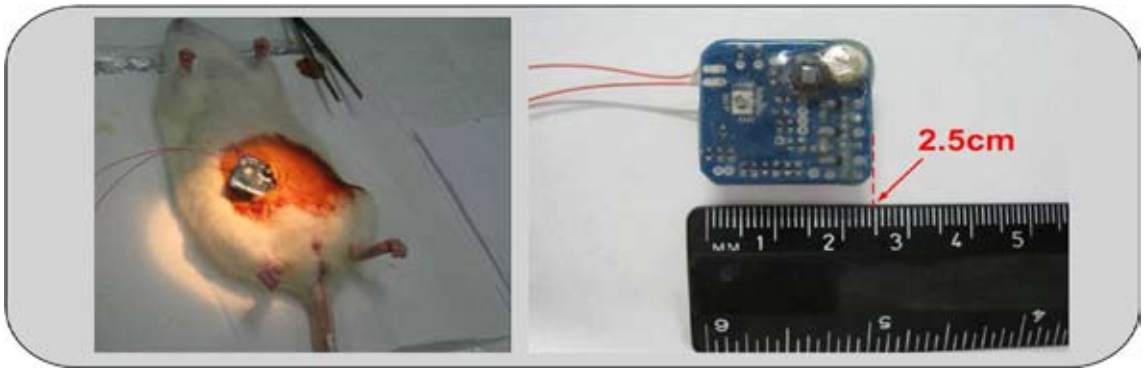
本計畫之另一特色為業界之積極參與，這些公司皆為國內外相關領域之代表性公司。這些公司除將以轉委託之方式以確保本計畫能順利完成系統整合之外，亦將是計畫成果之優先技轉對象。由於這些公司與本計畫密切之合作關係，不僅提高技轉意願，亦將提高本計畫之落實成效。



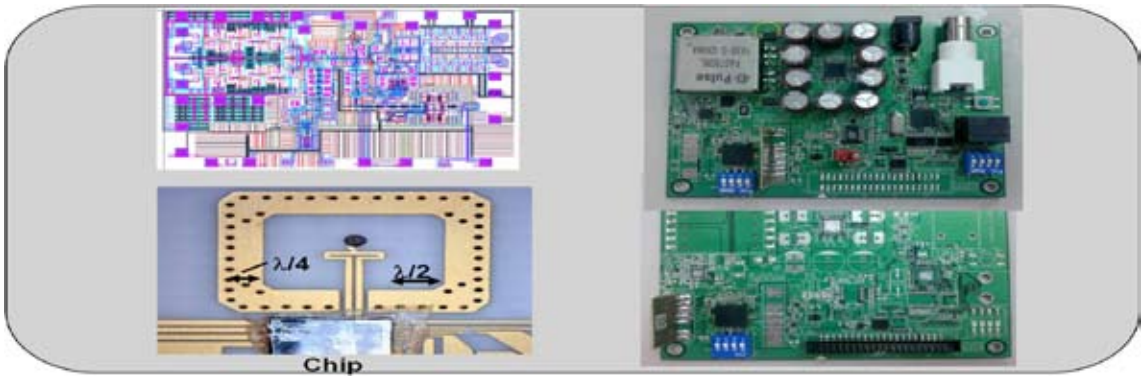
分項計畫一：低功率無線傳輸



分項計畫二：可攜式超音波影像儀



分項計畫三：無線神經電刺激



分項計畫四：寬頻無線影像傳輸

Project title: Development of Advanced Biomedical ICs and Integration of Medical Systems
Supported by: Ministry of Economic Affairs
Project period: 2009/09/01 - 2012/08/31

The long term goal of this integrated project is to develop next generation biomedical electronics and system integration technologies for biomedical applications. By combining low power wireless transmission, advanced adaptive imaging technologies for portable devices, high performance digital signal processing engine, GPU-based medical computing platform, wireless power transmission and 60 GHz wireless transmission, leading technologies will be developed and transferred to the industry for important biomedical applications. The research team of this project consists of outstanding researchers from disciplines of engineering, medicine and fundamental sciences. In addition, the following three system platforms will be used as vehicles for technology development: low power/wireless physiology monitors, portable adaptive ultrasonic imaging system and wireless neural stimulator. To achieve these goals, the project will consist of the following main items:

- Low power wireless communication
- Adaptive ultrasonic imaging methods on portable platforms
- Ultrasonic wireless power transmission
- Wireless neural stimulator
- 60 GHz transmitters and receivers for imaging applications
- Miniaturized piezoelectric sensors

The success of this project will put the research team in the forefront position in the world, and assist the transformation of domestic IT industry to next generation biomedical electronics businesses.

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生醫晶片技術實驗
Bio-Electronics-System Technology Lab.

本實驗室成立於2006年，主要研究方向為奈微米生醫晶片系統相關研究，目前以生物分子檢測技術與微細胞監測技術等領域為研究重點。進一步的說明，整合現今蓬勃發展的奈微米製程科技與傳統生物科學知識，可以發展出極具應用及發展潛力之關鍵性跨領域技術，因此，本實驗室致力於開發不同之生醫電子應用晶片與系統，期能在相關領域獲得良好之成果與能見度。本實驗室之成員來自電子及工程等相關領域，以此為基礎，積極與生醫相關領域學者進行合作，合作領域及研究範疇涵蓋基礎科學、工程技術與臨床研究等。

The bio-related research activity is one of the major focuses in world wide research institutes. However, the advancement of bio-research is limited by costly instruments and time consuming analysis. To overcome this obstacle, in our research group, the nano-electronics and micro-mechanism are integrated to be a powerful tool for this emerging research field.

More specific, a series of bio-chemical molecular sensors can be developed by utilizing nano-scale electrical devices. Based on the superior fabrication facilities and skills in Complementary Metal-Oxide- Semiconductor (CMOS) and Nano/Micro Electro-Mechanical System (N/MEMS), moreover, micro protein sensor arrays technologies and living cell monitoring systems are also envisioned to be an exciting research direction. In summary, our research is aiming at developing innovative and integrated systems for nano/bio research fields.

主要研究領域 Major Research Areas

奈微米生物機電系統、生物晶片、生物分子量測技術、奈米製程技術、生物微感測器、軟性噴墨電子技術
Bio-NEMS, Bio-Chip, Nano fabrication, Biomolecular Detection Technology, Inkjet Printing Organic Electronics

研究計畫 Research Projects

1. 奈米場效生物分子感測元件
   Nano FET Biomolecular Sensor
2. 細胞監測晶片研發
   In-Vitro In-Situ Cell Monitoring Chip
3. 奈米螺旋碳管能源擷取元件
   Energy Harvesting Devices Based on Nano- Carbon-Coils
4. 無線感測器網路平台技術開發
   Wireless Sensor Network Platform Technology

計畫名稱：智慧型奈米多晶矽心血管疾病生物標誌診斷系統晶片之研發
補助單位：行政院國家科學委員會
計畫期間：2011/08/01 - 2014/07/31

心臟冠狀動脈(Coronary Artery Disease)退化及心肌退化症，往往會使患者過勞或進行一些劇烈活動時，引起心絞痛甚至造成患者死亡，已經成為國人十大死因之第二名。雖然近幾年來醫學上對於治療心血管疾病有相當之進步，但心臟衰竭之治療仍具有相當之挑戰性及極限，因此如何提供心衰竭患者全面性的照護，是刻不容緩的議題。其中，最為重要的即為心衰竭的長期及緊急照護之用藥，然而，用藥的效果及用量，會因為心衰竭病患基因之不同而有不同的感受性，因此，如何進一步利用DNA晶片技術進行檢驗及資料篩檢即成為心臟疾病相關早期預警及輔助用藥等生醫照護科技下一步重要的發展。

本研究團隊針對此一課題發展以標準半導體製程為基礎的DNA檢測晶片系統。本研究團隊計劃將以對DNA分子及元件表面處理的了解做為為基礎，利用對奈微米電子元件的知識為工具，先以元件理論分析的方式來建構此一DNA檢測晶片的基礎模型，而後以標準半導體製程技術進行DNA檢測晶片及其相關電路之設計及製作，進一步與臨床資料進行分析比對，期能使國內生物感測元件知識與技術可以確實與臨床治療技術更進一步的整合，並可藉由國內獨步全球之半導體製程技術將此一研究成果落實於生物科學之應用層面上，以提升既有之產業價值。

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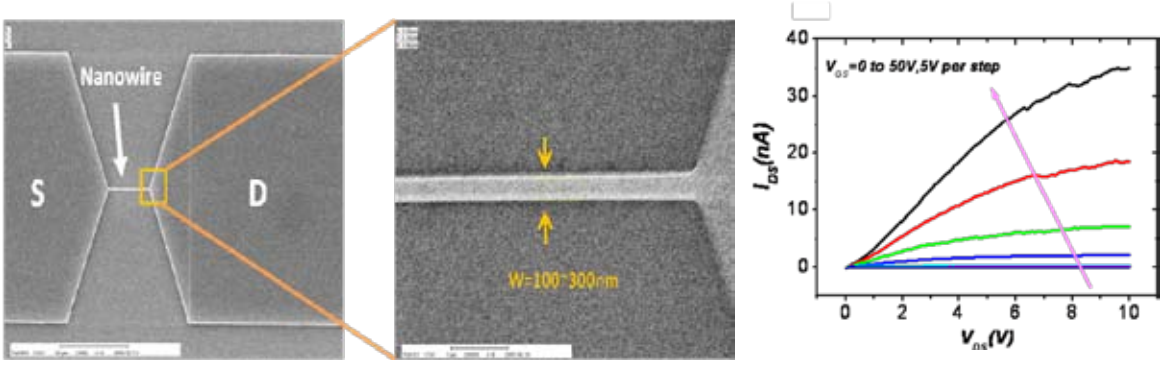
Project title: The development of poly-silicon nanowire sensor-system-on-chip for biomarkers in heart failure diagnosis
Supported by: National Science Fundation
Project period: 2011/08/01 - 2014/07/31

With rapid advancements of System-On-Chip and MEMS/nanotechnologies, a wide variety of new chemical analysis devices and their integrated system, such as biomolecular analysis devices and micro-total-analysis systems, have been designed, implemented, and demonstrated. However, few of them integrated with clinical analysis and achieve the practical requirement of the modern biomolecular diagnosis. As the consequence, this research project will aim at the development of DNA analysis system-on-chip for the clinical heart-failure-medicine-treatment, which is one of the most important steps toward the heart failure disease treatment in both emergency and chronic recovery. In specific, this research project will be based on the basic understanding of electronic devices, biomolecular interaction, and nano/micro fabrication to design and implement the DNA chip for heart-failure medicine treatments. Furthermore, this research project will also compare with clinical data in order to bridge the electronics, bioinformatics, and clinical applications into a fully integrated system.

代表圖及中英文說明：



掃描式電子顯微鏡(SEM)拍攝多晶矽電晶體元件及通道。右圖為奈米線通道的多晶矽電晶體Ids-Vgs 電性圖（L/W = 10um/300nm，熱氧化二氧化矽=1um），右圖為奈米線通道的多晶矽電晶體Ids-Vds 電性圖（L/W =10um/300nm，熱氧化二氧化矽=1um）。

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醫用微感測器暨系統實驗室
Medical Micro Sensor and System Lab.

本實驗室致力於配合醫療儀器認證與驗證法規之推動與精神體現，以微機電技術與光學感測方式進行生醫奈微米微感測器元件與系統整合之研究與應用-包括表面電漿共振(surface plasmon resonance)原理，表面電漿子感測器設計、微型系統整合、軟硬體介面溝通，主旨在於發展快速、便利、正確、與人性化醫用感測儀器，以促進個人化醫學(personalized medicine)與電子化醫療(e-health)之研究與產業發展。

We have devoted to apply microfabrication technologies and optical sensing mechanisms to develop nano/micro sensors and integrated system for the medical applications with compliance of medical device regulations and standards. Our research currently focus on the theoretical development for novel Surface Plasmon Resonance (SPR) devices, design of SPR nano/micro sensor, bioplamonics, and the heterogeneous integration of micro-system from hardware to software. The aim is to develop the fast diagnosis, easy to use, and user-friendly medical devices toward the success of personalized medicine and e-health.

林啓萬教授受邀參展--竹北醫學園生醫研發中心成立暨生技大樓啓用典禮2011.5.18-20

林啓萬教授受邀參展--竹北醫學園生醫研發中心成立暨生技大樓啓用典禮2011.5.18-20

主要研究領域 Major Research Areas

生物微感測器與系統、生醫晶片、生醫光電、類神經網路、醫材法規
Bioelectronics, Biomedical Micro sensors and System, Biochip, Biomedical Optics, Artificial Neural Networks, Regulatory Affairs

研究計畫 Research Projects

1. Continuous Cell Culture Monitoring System
2. 結核菌標準化血清抗體及丙型干擾素快速檢測系統之開發及應用
   Development of standardized rapid Mycobacterium diagnosis platforms: serum antibody and interferon-γ detection
3. 無線心音量測與分析系統開發
   The development of wireless heart sound measurement and analysis system
4. 新型超解析度電漿子成像平臺於量測單分子奈米陣列交互作用之研究(2/3)
   Novel Super-resolution Plasmonic Imaging Platform for Measurement of Single Molecular Interactions on Nano Array(2/3)

計畫名稱：新型超解析度電漿子成像平臺於量測單分子奈米陣列交互作用之研究
補助單位：行政院國家科學委員會
計畫期間：2009/08/01-2012/07/31

基於先前的初步研究成果與經驗，本計畫擬使用plasmonic nanolithography取代原先DPN製做生物奈米陣列樣版的方法，使用DPN於後續的多種生物分子塗佈標的優點，對奈米生物晶片進行加工。生物分子預計採用有接抗原之奈米粒子（直徑>=50奈米）與ALV病毒顆粒（約100奈米）達到在一個直徑50奈米的陣列點上因為空間限制只允許單一分子交互事件的發生。在觀測的架構部分，除了嘗試以高NA物鏡在穿透式架構下改善原先暗場顯微鏡的解析度外，達到直接觀測100奈米下的標的物目標之外，也將跟法國Ecole Normale Supérieure de Cachan, Prof. Dominique Chauvat與臺大李世光教授合作的Radially-polarized SPRM進行合作量測，以掃描或二維影像方式觀測奈米陣列上生物分子反應的動態折射率變化，達到非標識(non-labeling)的觀測。最後取得的訊號將與傳統使用表面電漿共振測量分子動態反應做比較，以驗證奈米尺度下生物分子的隨機行為模型。此一整合奈米製程與光學檢測技術之Stochastic Array研究在目前全世界的研究中尚在起步中，本團隊在長期合作努力下有希望獲得實用的突破在高度創新的生物感測器領域獲得領先地位。

Project title：Novel Super-resolution Plasmonic Imaging Platform for Measurement of Single Molecular Interactions on Nano Array
Supported by：National Science Council
Project period：2010/08/01-2012/07/31

Based on our preliminary results and experiences, this project propose to use surface plasmon (SP) nanolithography to replace the original method that is DPN to make the template for the biomolecular nanoarray. Then, this chip will be processed by DPN that has

an advantage of depositing various molecules at one time. The target molecules will be the artificial nanoparticles with a diameter of lager than 50 nm or AIV virus particle (diameter is about 100nm), which makes one site of dot (50 nm) react only with one particle. That is, there is only one event that will take place on one site due to the limitation of dot size. Regarding the observation, except to use the high NA objective lens to improve the resolution of microscopy for detecting the structure under 100 nm, we will measure these events using racially polarized surface plasmon resonance (SPRM), which is the co-work result by Prof. Zyss (Ecole Normale Supérieure de Cachan, France), Prof. Chauvat (Ecole Normale Supérieure de Cachan, Fance) and Prof. CK Lee (Institute of Applied Mechanics, NTU), to measure the reflective index change caused by biomolecular interaction with scanning or imaging the 2-D image for non-labeling observation. Finally, this experimental data will compare to that measured by conventional SPR method to identify the stochastic model of biomolecular interaction under nanometer scale. It is hopeful to obtain practical breakthrough and to obtain the leading ship in the field of biosensor based on our long-term cooperation and hard work.

計畫架構與進行方式

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人腦實驗室
Brain Imaging and Modeling Lab.

近年來，科學界逐漸了解複雜的人類行為與認知功能是藉由腦中不同階層的神經系統交互作用所表現出來，而非由單一的結構所掌控，有鑑於此，欲進一步了解人腦功能，則需要在結構與功能層面上研究以下三個問題：(1)什麼地方發生活動 (2)這些活動是何時發生以及其發生順序為何 (3)是如何藉由在大規模的神經網路中的訊息傳遞完成這些認知行為。現代非侵入性的醫學影像技術可幫助我們獲得高空間與時間解析度的神經活動資料，而定量的系統模擬將有助於解譯隱含於這些神經影像資料中協同完成感官、認知與行為歷程的動態神經活動。

本實驗室的研究方向為整合硬體研發、資料分析、與數值模擬等工程技術來幫助我們了解複雜的人腦功能。進行中的研究計畫集中於結合結構與功能性核磁共振影像，腦磁圖與腦電圖之高時間空間解析度的神經影像技術，以及系統階層的神經信號模擬，以了解神經活動與行為間的關係。

Complex behavior and cognitive functions of the human brain are suggested to be "mapped at the level of multi-focal neural systems rather than specific anatomical sites, giving rise to brain-behavior relationships that are both localized and distributed". Further understanding of these brain mechanisms requires both structural and functional knowledge to answer (i) where are the foci of activity, (ii) when are these areas activated and what is the temporal sequence of activations, and (iii) how does the information flow in the large-scale neural network during the execution of cognitive and/or behavioral tasks. Advanced noninvasive medical imaging/recording modalities are able to localize brain activities at high spatial and temporal resolution. Quantitative modeling to interpret these data is needed to understand how large-scale distributed neuronal interactions underlying perceptual / cognitive / behavioral functions emerge and change over time.

Our research interests include the integration of hardware development, data analysis, and mathematical modeling to facilitate our understanding of brain cognition. Current research projects try to explore challenges of spatiotemporal brain imaging and modeling by using a combination of hardware and analytical approaches to enhance the spatiotemporal resolution of single (MRI) or combined (MRI/fMRI and MEG/EEG) modalities. In addition, mathematical approaches for identifying large-scale neural networks and their correlation to behavioral measurements are investigated.

主要研究領域 Major Research Areas

神經影像、核磁共振影像、腦磁圖、腦電圖、神經系統模擬
Neural imaging, Magnetic resonance imaging, Magnetoencephalography (MEG), Electroencephalography (EEG), Neuronal modeling

研究計畫 Research Projects

1. 國科會計畫 -【超快速人腦功能性核磁共振逆影像】
   Ultra-fast functional magmetic resonance inverse imaging of the human brain
2. 國科會計畫 -【利用多種神經影像進行人腦視覺系統之時空映象與系統模擬】
   Multimodal spatiotemporal brain mapping and modeling of human visual system
3. 國家衛生研究院計畫 -【高時間高空間解析度之正規化平行核磁共振影像擷取與重建】
   Regularized parallel MRI acquisitions and reconstructions for high spatiotemporal resolution
4. 國立臺灣大學邁向頂尖大學前瞻性研究計畫 -【使用三維核磁共振逆影像技術抑制高場腦功能性核磁共振影像之生理雜訊】
   Physiological Noise Reduction Using Volumetric Functional Magnetic Resonance Inverse Imaging

計畫名稱：利用多種神經影像進行人腦視覺系統之時空映像與系統模擬
補助單位：行政院國家科學委員會
計畫期間：2009/08/01-2012/07/31

本計畫旨在發展一完整的時空映像與系統模擬實驗與分析架構，以應用於人腦感覺、認知與行為的研究。我們認為人類複雜的行為是由於腦內空間不同的區域在時間與空間上相互協調才能產生，而非單一解剖學上的位置所能獨力完成。近幾年來，我們已經發產了一系列時空映像的工具幫助我們達成以非侵入性的方式了解人腦視覺系統的目的。我們將持續這些技術以提高它們的時間和空間解析度，同時也將研究腦內是如何使用遠距同步(long range synchronization)的方式來傳遞和整合訊息。最終希望能了解人腦內在處理感覺與運動的過程中各區域間的因果關係(causality)。

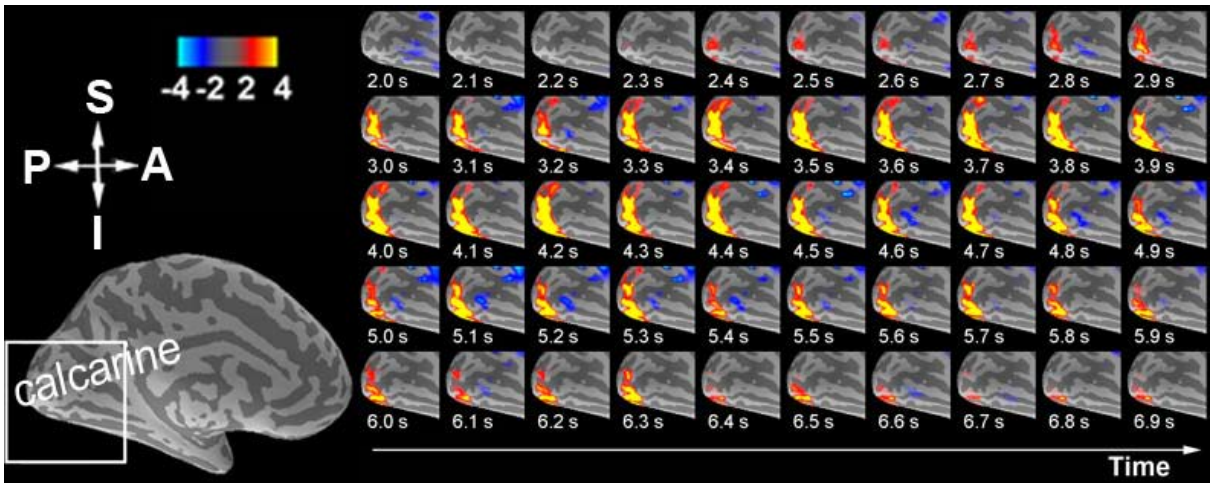
為了達成上述目標，我們發展結合功能性核磁共振影像(functional magnetic resonance imaging, fMRI)與腦電波／腦磁波圖(EEG/MEG)的方式來取得空間上達釐米精準度與時間上達毫秒精準度的神經影像。我們將進一步整合功能性核磁共振影像與腦電波/腦磁波圖的資料擷取，改進新發展之核磁共振逆影像技術(magnetic resonance inverse imaging) 。並利用相位同步的概念探討腦內電訊號如何傳地震盪訊號，進一步在時域以及頻域上量化腦部各區域間的葛氏因果關係(Granger causality) 。最後應用這些技術來研究注意特徵(feature-based attention)在人腦高階視覺中的神經基礎。本計畫所發的各項神經影像工具與視覺研究希望能對臨床科學與神經科學能有所助益。

Project title: Multimodal spatiotemporal brain mapping and modeling of human visual system
Supported by: National Science Council
Project period: 2009/08/01-2012/07/31

The overall goal of our research program is the development of a comprehensive experimental and analytical framework for spatiotemporal imaging and modeling of the neural basis of perception, cognition and action. According to our general model, complex behavior results from the coordinated activity of spatially distributed neural systems rather than specific anatomical sites, giving rise to brain-behavior relationships that are distributed in space and time. To date, we have developed a range of spatiotemporal imaging methods that have enabled innovative, non-invasive studies of the human visual system at higher resolution spatial and temporal resolutions than previously achieved. We now propose to carry forward the development of our spatiotemporal imaging approach by exploring methods for acquiring functional brain imaging data at ever higher rates, probing the brain mechanisms for long-range spatial synchronization and achieving a better understanding of information flow during perceptual and sensorimotor processing by establishing a robust framework for causal modeling.

To these ends we have developed novel methods combining functional MRI (fMRI) and magnetoencephalography / electroencephalography (MEG/EEG) data to obtain noninvasive spatiotemporal maps of cerebral activity with both high temporal (millisecond) and spatial (millimeter) resolution. We propose to continue and extend this technical development. Specifically, we will further improve fMRI and MEG/EEG data acquisition and analysis methods, develop new methods to explore mechanisms of oscillatory brain activity combining fMRI, MEG and EEG data, thereby increasing the accuracy and sensitivity of the spatiotemporal brain imaging approach. Further, we will continue development of causal modeling approaches, allowing study of how large-scale distributed neuronal interactions give rise to perception and cognition. Finally, we will apply these technical advances to studies of human higher visual processing in healthy individuals to study the neural mechanisms of feature-based attention. Given the increasing availability of both MRI and EEG/MEG, our combined approach should have significant impact on understanding the neural basis of behavior.

代表圖及中英文說明：



單一受試者對於視覺刺激以100毫秒解析度INI重建之功能性核磁共振影像(fMRI)時間序列 (TR/TE = 100/30毫秒，Flip angle = 20度，視野 = 200微米)。本實驗使用32通道頭部線圈陣列，資料從128次隨機呈現的刺激中取得，每此測試包含了6秒的baseline，跟接下來的0.5秒8Hz閃爍棋盤格刺激，以及接下來的23.5秒後刺激期 (每次總共30秒)。圖上的時間標記指的是閃爍棋盤格刺激開始後的時間。

A single-subject 100-ms resolution INI fMRI time series of activations to visual stimulation (TR/TE=100/30 ms, flip angle 20º, FOV=200 mm), co-registered to a flattened region of the left occipital cortex. The data were obtained using a 32-channel head coil array in 128 randomized trials, each of which consisted of 6 seconds pre-stimulus baseline, followed by 8-Hz flashing checkerboard flashing for 0.5 sec and subsequently 23.5 s post-stimulus (30 sec in total for each trial). The time stamps labeled in the figure indicate time after onset of the flashing checkerboard.

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整合神經生理學實驗室
Integrative Neurophysiology Lab.

本實驗室成立於1999年，主要從事整合性之電氣生理學相關議題研究，目前以脊髓神經反射塑性等領域為研究重點。在該領域本實驗室已發表相關著作。

Integrative Neurophysiology lab was founded in 1999, with the main research focus on systemic neurophysiology. In the past few years, we have conducted a number of research projects and published several articles in spinal reflex potentiation.

主要研究領域 Major Research Areas

神經生理學、感覺神經生理學
Neurophysiology, Sensory physiology

研究計畫 Research Projects

一氧化氮媒介之電針刺激-引發尿道反射增益現象及參與之細胞內訊息傳遞路徑

計畫名稱：探討電針刺激調控尿禁制與其在脊髓上的相關機制
補助單位：行政院國家科學委員會
計畫期間：2009/08/01-2012/07/31

尿失禁 (Urinary incontinence) 是現代婦女常見的一項疾病，因工作關係而長期性的憋尿，導致膀胱功能的失調；因生產時所造成的骨盆底肌肉損傷；或因停經時，所造成的陰道及尿道黏膜萎縮老化，都會造成不同程度的尿失禁，而隨著漏尿和頻尿的發生，社交活動亦逐漸減少，使生理或心理層面上都飽受煎熬，所以解決尿失禁問題為今日婦科學所重視的一項重要議題。過去有文獻指出電針刺激 (electroacupuncture) 中極、關元、足三里、三陰交等穴位，可提升骨盆底肌肉的張力，進而改善膀胱的功能。近年來，本實驗室以低頻 (1Hz) 模式重複性電刺激 (repetitive stimulation) 骨盆傳入神經 (pelvic afferent nerve)，使電訊號上行至脊髓 (spinal cord) 經由Onuf神經元 (Onuf nucleus) 整合訊號後，再由外陰部傳出神經 (pudendal efferent nerve) 將此訊息下行至外尿道括約肌 (external urethral sphinctrer, EUS)，發現此迴路的肌動作電

位有增益現象 (potentiation) 產生，我們實驗室把此現象定義為脊髓反射增益現象 (Spinal Reflex potentiation, SRP)，推測此增益現象是膀胱儲尿期 (storage phase) 使尿液禁制 (continence) 的一項重要機制。於第一年的實驗，我們分別在低頻及高頻模式下電針刺激三陰交 (Sanyinjuao; SP6)，並配合我們以建立的實驗動物模式 SRP (spinal reflex potentiation) 來討論其對尿液禁制 (Urinary continence) 與脊髓間 (spinal cord) 的交互作用關係為何。呈接上一年的實驗裡，我們預測分別在低頻 (Low frequency) 及高頻 (High frequency) 模式下電針刺激三陰交 (Sanyinjuao; SP6)，會造成類似長期壓抑現象 (Long-term depression, LTD) 及長期增益現象 (Long-term Potentiation, LTP) 產生，於第二年，我們將繼續針對低頻 (Low frequency) 刺激三陰交所造成的LTD，使用藥理阻斷探究造成此骨盤-尿道反射回路改變的細胞內訊息機制為何，及此層次上所參與的神經傳導物質對此現象有何影響，並且利用免疫化學組織染色，從型態上去觀察其變異。第三年，我們將繼續針對高頻刺激三陰交，並以藥理方式嘗試阻斷這一現象，以便作為治療尿失禁 (Urinary incontinence) 病人的參考依據，探究造成此骨盤-尿道反射回路改變的細胞內訊息機制為何。

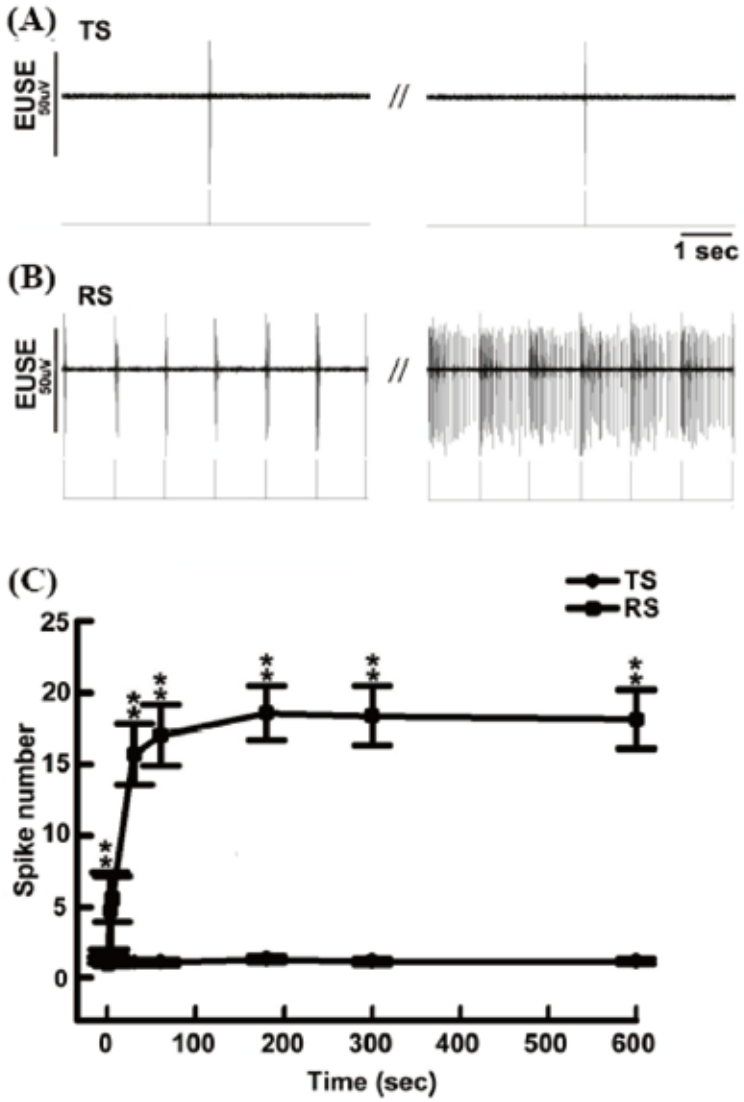
Project title: The spinal mechanism involved in the modulation of urine continence caused by electroacupuncture
Supported by: National Science Council
Project period: 2009/08/01-2012/07/31

Urinary incontinence, which cause by long term leaking result of bladder dysfunction or cause by childbirth result of pelvic muscle damage, is one of the common diseases in the female at modem society. After menopause, degeneration of the mucous membrane of vagina and urethra might cause different extent of urinary incontinence. Since urinary continence, which is characterized by urine leakage, community rushing, made physiology and psychology suffer too much, it is important theme in gynecology today to discuss the improvement of urinary incontinence.

Previous studies had reported that stimulation at acupuncture point of CV3, CV4, ST 36, SP6 could enhance the tension of pelvic muscle to improvement bladder function. Recent years, our laboratory has demonstrated an animal model that low frequency (1Hz) repetitive stimulation pelvic afferent nerve may excite spinal Onuf nucleus, and then via pudendal efferent nerve, to induce contraction of external urethral sphinctrer (EUS). This phenomenon, which was first presented by our laboratory to underlie the spinal continence mechanism, is called spinal reflex potentiation (SRP).

In this study, we investigate the possibility that acupuncture might affect the induction of SRP to participate in the continence. Anesthetized rats will be use to develop adequate animal model for this hypothesis. We will stimulate the acupuncture point, SP6, using different frequency to induce contraction of urethra, which is essential for urine continence at the first year. Moreover, pharmacological agonists/ antagonists will injected using various routes to elucidate the neurotransmitter/neuromodulator involved in the development of SRP. In addition the expression levels of NMDA protein will be analyzed using Western blotting and immunohistochemistry investigation will be carried out to elucidate the cellular mechanism involve in such a acupture-related modulation on continence at the spinal cord level.

代表圖及中英文說明：



本圖分別以測試性電刺激 (TS)，及反覆性電刺激 (RS) 刺激腹直肌引發外尿道括約肌的活動性。
Illustration of test stimulation (TS) and repetitive stimulation (RS) induced pelvic-urethral reflex activity.
EUSE: external urethral sphincter electromyogram（尿道外括約肌肌電圖）
TS: Test stimulation（測試性刺激, 1/30 Hz）
RS: Repetitive stimulation（重複性刺激, 1 Hz）

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演算法實驗室
Algorithmic Research Lab.

演算法實驗室於2005年成立，目前我們有八位博士班學生與十九位碩士班學生。本實驗室的研究專注於基礎演算法的設計、分析以及應用。

The Lab of Algorithmic Research was established in 2005. We currently have 8 Ph.D. students and 19 master students. Our research focuses on fundamental algorithms and their applications.

主要研究領域 Major Research Areas

演算法、圖論、生物資訊
Algorithms, Graph Theory, Bioinformatics

研究計畫 Research Projects

1. 平面圖之「簡潔編碼」與「簡潔呈現」演算法
   algorithms for succinct encodings and compact drawings of planar graphs
2. 動態簡潔資料結構
   Succinct dynamic data structures

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計畫名稱： 動態簡潔資料結構
補助單位： 行政院國家科學委員會
計畫期間： 2009/08/01-2012/07/31

我們希望在動態簡潔資料結構的研究上，探討如何設計有序根樹的動態編碼。有序根樹(ordinal tree)是一種有根樹，每個樹節點的所有子節點都有固定的順序排列。我們希望能對有序根樹設計出一套動態編碼，達成下列兩個目標：
1. 希望編碼所需的儲存空間，在最高項達到資訊理論上的最佳解。
2. 希望編碼能夠有效率地回答一些對有序根樹的查詢，和支援樹上節點的動態更新。

在靜態簡潔資料結構的研究領域，針對有序根樹的文獻已有廣泛的探討，但在允許快速更新樹節點（新增和刪除）的動態簡潔編碼研究上，迄今相對少見。目前已知最好的結果是由 Chan、Hon、Lam、和 Sadakane 在 2005 (2007)年，以及 Arroyuelo 在 2008年所提出的編碼。基於一棵有 n 個節點的樹和 2n 個括號的平衡字串的關係，Chan 等學者針對動態平衡字串，提出第一套使用線性空間的動態編碼方案。他們的結果包含兩種動態編碼，針對不同的查詢，達到O(lg n) 時間和 O(lglg n) 時間的回答和更新效率。學者 Arroyuelo 則進一步將儲存空間降低到 2n + o(n) 個位元，其最高項已達到資訊理論上的最佳解，他們的編碼能在 O(lg n) 時間內支援節點的更新，以及更多種查詢。我們盼望能在有序根樹的簡潔動態編碼設計上，進一步改良現有的方案，研究如何開發新的輔助資料結構，有效率地同時支援樹節點的更新，以及更豐富的查詢。

Project title: Dynamic Succinct data structures
Supported by: National Science Council
Project period: 2009/08/01-2012/07/31

We study the problem of designing succinct dynamic data structures and focus on representing dynamic ordinal trees succinctly. An ordinal tree is a rooted tree where the children of each node are ordered. On the unit-cost RAM model with (lg n)-bit words, we would like to develop a succinct dynamic encoding for an ordinal tree to achieve the following objectives:

1. minimizing the space usage of the encoding to match its information- theoretical lower bound in the first-order term.
2. supporting efficient queries and updates in the worst-case time complexity.

While succinct representations for static trees have been extensively studied, the literature is limited on dynamic cases which permit efficient updates (insertion and deletion of arbitrary nodes). The best currently known dynamic encoding for trees are due to Chan, Hon, Lam, and Sadakane in 2005 and 2007, and Arroyuelo in 2008. Based on the natural association between an n-node tree and a sequence of 2n balanced parentheses, Chan et al. gave the first linear space solutions for the dynamic parentheses maintenance problem. They proposed two different O(n)-bit encodings with time efficiency of O(lg n) and O(lg n/ lg lg n) respectively, supporting updates and few queris. Arroyueloe reduced the space to 2n + o(n) bits, whose first-order term is information-theoretically optimal, and supported more queries in O(lg n) time. We propose to improve the results of of Arroyuelo and Chan et al. to achieve a 2n + o(n)-bit encoding for an n-node ordinal tree. We would like to obtain new o(n)-bit auxiliaries that enrich the set of supported queries, and achieve better performance as well for updates in the worst-case poly-logarithmic time.

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分子生醫資訊實驗室
Molecular Biomedical Informatics Lab.

分子生醫資訊實驗室專注於設計先進的機器學習演算法以應用於系統生物學的研究上。在過去幾年中，實驗室團隊提出三個創新的機器學習演算法並運用這些演算法以發展以下幾項生物資訊軟體工具：

1. HomoClust—以蛋白質序列比對為基礎建構蛋白質家族的階層架構
2. iPDA—蛋白質非穩定結構區段之預測
3. Proteminer and Protemot—以局部蛋白質結構比對為基礎預測蛋白質功能
4. MEDOCK—模擬蛋白質與配體嵌合
5. Prote2S—預測蛋白質二級結構
6. ProteDNA—預測轉錄因子上與DNA鍵結殘基

The Molecular Biomedical Informatics (MBI) laboratory focuses on design of advanced machine learning algorithms for systems biology research. During the past few years, the MBI team has proposed three innovative machine learning algorithms and has exploited these algorithms to develop various bioinformatics software tools including:

1. HomoClust — construction of protein family hierarchy based on sequence alignment;iPDA — prediction of disorder regions in protein sequences
2. Proteminer and Protemot — prediction of protein functional sites based on local structural alignment
3. MEDOCK — emulation of protein-ligand docking
4. Prote2S — prediction of protein secondary structures based on the polypeptide sequence
5. Prote2S — prediction of protein secondary structures based on the polypeptide sequence
6. ProteDNA — prediction of sequence specific DNA binding residues in transcription factors

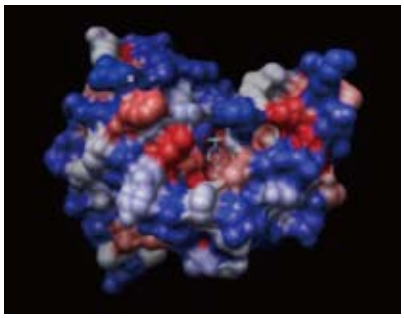
主要研究領域 Major Research Areas

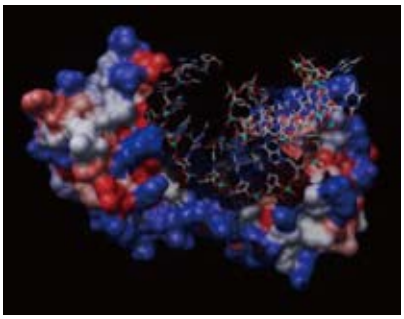
生物資訊學、機器學習
Bioinformatics, Machine Learning

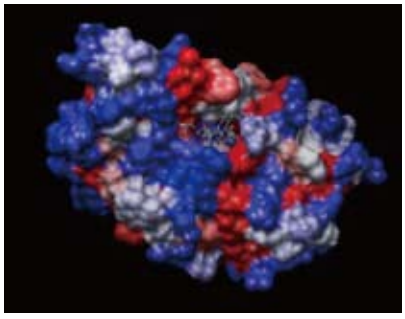
研究計畫 Research Projects

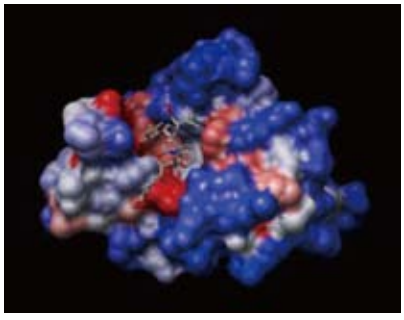
1. 以自動知識擷取為基礎之計算功能性蛋白質體學
   Computational functional proteomics based on automated knowledge extraction
2. 計算生物學先導型研究計畫
   Pilot Research Program of Computational Biology

計畫名稱：以自動知識擷取為基礎之計算功能性蛋白質體學
補助單位：行政院國家科學委員會
計畫期間：2009/08/01 – 2012/07/31









本整合計畫的終極目標，是設計以精確的能量評估函數為核心的生物資訊預測軟體，以期能精確地分析蛋白質/蛋白質交互作用（protein-protein interactions簡稱PPI）、蛋白質/DNA交互作用（protein-DNA interactions）、以及蛋白質/配體交互作用（protein-ligand interactions）的細節。由於本團隊將建構下列3項獨特的基礎，預期本計畫中所提出的能量評估函數將具有突破性的精確度：

1. 運用資訊擷取(information extraction)技術，以自動化的方式由文獻中擷取蛋白質結合強度的資訊，以建立最完整的蛋白質結合強度資料庫；
2. 確認影響結合自由能的關鍵因子並設計創新且高效率的評估演算法；
3. 設計創新性的非線性迴歸演算法以及多變量分析演算法。

以本計畫所提出的精確能量評估函數為核心，本團隊將設計最先進的分子嵌合模擬軟體、蛋白質功能預測軟體、蛋白質結合區預測軟體、DNA上轉錄因子結合區預測軟體等。由於蛋白質在所有的生化反應與生理作用中均扮演了最基礎的角色，因此本計劃所研發的生物資訊預測軟體，不僅能夠被有效地運用於許多生命科學的基礎研究上，同時亦可以提供分子診斷與醫療(molecular diagnosis and therapy)研究上創新性的分析工具。

Project title: Computational functional proteomics based on automated knowledge extraction
Supported by: National Science Council
Project period: 2009/08/01-2012/07/31

The ultimate objective of this integrated project is to design advanced bioinformatics software for analyzing the details of protein-protein interactions, protein-DNA interactions, and protein-ligand interactions based on the accurate energy scoring functions proposed by this integrated project. It is anticipated that with the following distinctive frameworks, the energy scoring functions developed by this integrated project will feature superior accuracy in comparison with the existing ones:

1. construct comprehensive binding affinity databases of protein-protein, protein-DNA, and protein- ligand interactions with automatic information extraction technology;
2. dentify critical energetic terms and design innovative and efficient evaluation algorithms;
3. design advanced non-linear regression algorithms as well as novel multivariate analysis algorithms.

With the advanced energy scoring functions, we will then move to design innovative computational methods and algorithms for implementations of molecular docking and predictors of protein functions, protein binding sites, and TFBS (transcription factor binding sites). As proteins play the fundamental roles at the molecular level in essentially all physiological processes, the advanced bioinformatics software designed in this integrated project will not only facilitate the investigations on many important physiological processes but also provide innovative analytical mechanisms for studies on molecular diagnosis and therapy.

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臨床-生物醫學工程-產業融合實驗室
Merger Laboratory for Clinical Sciences, Biomedical Engineering and Industry

本融合實驗室由孫維仁教授成立於1992年，主要工作是從臨床服務的病患需求觀點，來提供醫療儀器與資訊處理之相關整合研究和產品研發。九〇年代開始，是以病患自控式鎮痛儀(Patient-Controlled Analgesia, PCA)導入數位化和無線化技術為主軸的急性疼痛服務提升，開發出 i-Pain®整合平台，並已和領先全球品牌進行緊密的結合。〇三年經歷SARS氣管插管爆發群聚感染的致命性災難時，本融合實驗室針對非感染性醫材的迫切市場需求，研發出可拋式內視鏡Sunscope®，獲得經濟部學界科專和產業的贊助，朝向全球商業市場邁進。三位一體的融合實驗室成立的宗旨就是要：敞開各專業的藩籬，主動並積極的邀集跨領域人才進行多元腦力激盪，讓一切研發終極目標導向臨床應用，通過醫師嚴格的臨床驗證，確保病患實際需求獲得超值滿足，以吸引產業關注和早期資本投入。

In 1992, Professor Wei-Zen Sun founded the merger laboratory in National Taiwan University Hospital. Based on the unmet demand from patient's perspective, we have successfully provided innovative development of medical devices and informatics through synergistic interaction among clinician, and biomedical engineer, and entrepreneur. We started by integrating the digital and wireless technology with conventional PCA pump (patient-controlled analgesia) to transform into an update web-based platform, i-Pain®. This product is currently adopted by a global leader brand and served as the major service module in Asia. In 2003, as SARS outbreak through non-protected endotracheal intubation, we developed the most advanced intubation device with disposable visual tube. This design totally eliminates the risk of air-borne lethal infection by avoiding close contact with patient's airway. This innovative product, Sunscope®, has won a first prized award and is currently supported by government grant and industry investment. Collectively, we establish this merger laboratory to trigger brainstorming among multidisciplinary specialties and to make sure that the cross-reaction of respective domain knowledge is taken place under the goal: to put forth any helpful effort and technology in synergy, to assess the product under critical assessment of clinicians, to bring in industry investment and commercial distribution for patient welfare.

主要研究領域 Major Research Areas

臨床與生物醫學工程與產業整合、疼痛醫學、麻醉醫學、緊急醫療
Integration of Clinical Science, Biomedical Engineering and Industry, Pain Medicine, Anesthesiology, Emergent Medical Service

研究計畫 Research Projects

1. *i*-Pain®（美商赫士睿公司技術轉移, Hospira, USA）
2. Sunscope®（經濟部學界科專委託計畫）
3. Lidopat® / Lidocap®（美時製藥合作）
4. 健保資料庫分析（歐陽彥正教授合作）
5. 遠距緊急救護監測－同步互聯醫療網：開發以緊急救護技術員為中心的移動式整合播放站（新北市消防局中長程計畫，送審中）

計畫名稱：遠距緊急救護監測－同步互聯醫療網：開發以緊急救護技術員為中心的移動式整合播放站
Interactive Telemedicine in Emergent Medical System: Emergent Medical Technician-Based Mobile Broadcasting Station
補助單位：新北市消防局中長程計畫（送審中）
計畫期間：2011 – 2013

本研究計畫將發展以緊急救護技術員（Emergency Medical Technician -EMT）為中心的無線救護通訊系統，有別於一般以救護車為資訊中心的方式。本計畫預計研發兩個模組以及一套軟體整合系統，兩模組分別為擁有3.5G無線發射功能之遠距離通訊裝置模組，另一模組為包含低耗電的藍牙（Bluetooth）4.0版本之近距離通訊裝置模組，整合系統則包括了患者影音資料庫的緊急救護資源整合平台，三部分所運用之技術如下所述：

1.遠距離通訊裝置模組（Long Range Transmission Module- LRTM）

本模組預計採用ARM Cortex A9 1.2GHZ處理器，內含3.5G及Bluetooth Module並且提供2組Audio/Video接點以及一組數位接點給予微型攝影機以及微型麥克風使用，生理量測儀器間的通訊方式將依ISO/IEEE 11073（X73）所訂定的規格標準來實作，傳輸介面則採用藍牙無線傳輸；遠距離通訊裝置模組將所收到的影音訊號壓縮後，以3.5G無線網路發送至緊急救護資源整合平台進行後續處理。

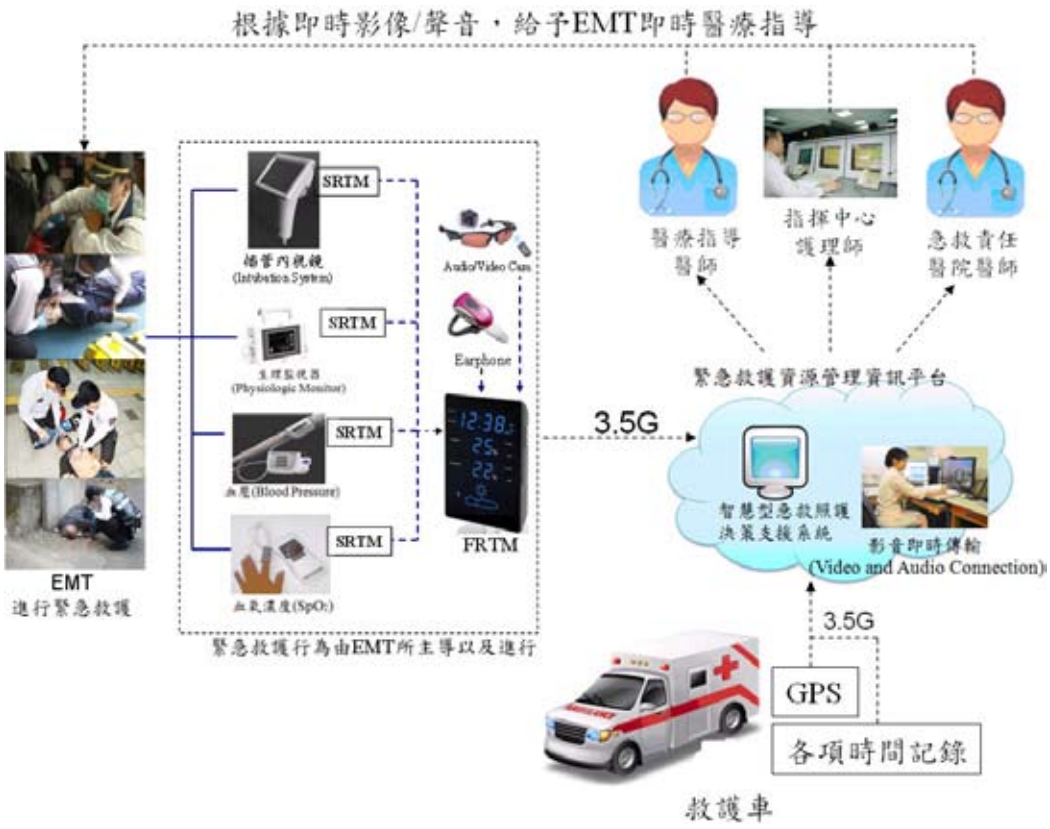
2.近距離通訊裝置模組（Short Range Transmission Module- SRTM）

本模組主要以低功率藍牙通訊協定作為各項儀器與遠距離通訊裝置模組溝通之橋樑，此模組主要將急救相關設備如攜帶式生理監視器、血氧濃度劑、插管型內視鏡、搜救型內視鏡等不具有無線傳輸功能的醫療裝置無線橋接至遠距離通訊裝置模組。

3. 緊急救護資源整合平台

救護資源整合平台則為遠距資訊的匯集站，此整合平台接受由各遠距離通訊裝置模組所發送出的IP Based訊號後，開始進行資料儲存以及發送，生理相關儀器資料依照IEEE 11073規範進行儲存，影音則儲存由遠距離通訊模組發送之H264之串流資訊，不另外進行壓縮；整合資訊的發送則透過網頁進行，僅持有相關權限者，如指揮中心護理師、醫療指導醫師、相關醫療人員等，可進入觀看、交互對談模式。

代表圖及中英文說明：



本系統以ARM架構的處理器為中心，使用3.5G行動通訊網路連結相關醫療設備，如帽沿攝影機、隱藏式麥克風、藍牙耳機、氣管插管內視鏡、血氧濃度器、攜帶型生理監視器等急救器材，即時將病患的生命徵象數值(vital sign)傳遞至緊急救護資源整合平台，使得相關醫療專業人員，如救護指揮中心的護理師以及地方急救責任醫院的醫師均可即時得知病患的狀況，並及對EMT給予即時的醫療指導，有效的促進EMT、救護指揮中心之派遣員、護理師及醫療指導醫師、地方急救責任醫院的溝通與資源整合，即時的經由EMT進行最恰當的處置，給予病患必要且適當的照護，提高救護的品質與病患的存活率，以EMT為資訊中心的資訊連結架構圖如圖所示。

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Professor, Department of Electrical Engineering, National Taiwan University.
Adjunct Research Fellow, Research Center for Applied Sciences, Academia Sinica.
Adjunct Research Fellow, Institute of Physics, Academia Sinica.

主要研究領域 Major Research Areas

非侵入式光學奈米影像與操控、兆赫波與微波生醫應用、奈米超音波
Non-invasive optical microscopy and manipulations, THz and Microwaves for biomedicine, nano-ultrasonics.

研究計畫 Research Projects

1. 倍頻式光學虛擬活體切片術
   Harmonics-based in vivo optical virtual biopsy
2. 建立同調拉曼顯微光譜所需之超短脈衝光纖光源
   Fiber-based light sources of ultrashort pulses for coherent Raman microspectroscopy
3. 奈米聲學與奈米超音波
   Nanoacoustics and nanoultrasonics
4. 使用兆赫波內視鏡檢測癌症的活體動物實驗
   Diagnose Cancer with THz endoscopes: Animal Studies in Vivo
5. 光纖化兆赫波影像與感測系統(3/3)
   Fiber-based THz imaging and sensing systems
6. 使用兆赫波內視鏡檢測癌症的活體動物實驗(2/3)
   Diagnose Cancer with THz endoscopes : Animal Studies In Vivo
7. 建立同調拉曼顯微光譜所需之超短脈衝光纖光源(2/3)
   Fiber-based light sources of ultrashort pulses for coherent Raman microspectroscopy

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8. 奈米超音波與奈米聲學(3/3)
   Nano-ultrasonics and nano-acoustics
9. 一種結合非線性光學顯微術與螢光生命期顯微術來篩檢肝癌的新光學指標
   Optical indices for the screening of hepatocellular carcinoma(HCC)with nonlinear optical microscopy and fluorescence lifetime imaging microscopy(FLIM)
10. 在體內諧波顯微影像對人類皮膚老化的研究
    In vivo harmonic generation microscopic imaging of human skin for studying skin aging
11. 奈米聲學與奈米超音波(1/3)
    Nano-acoustics & Nano-ultrasonics(1/3)

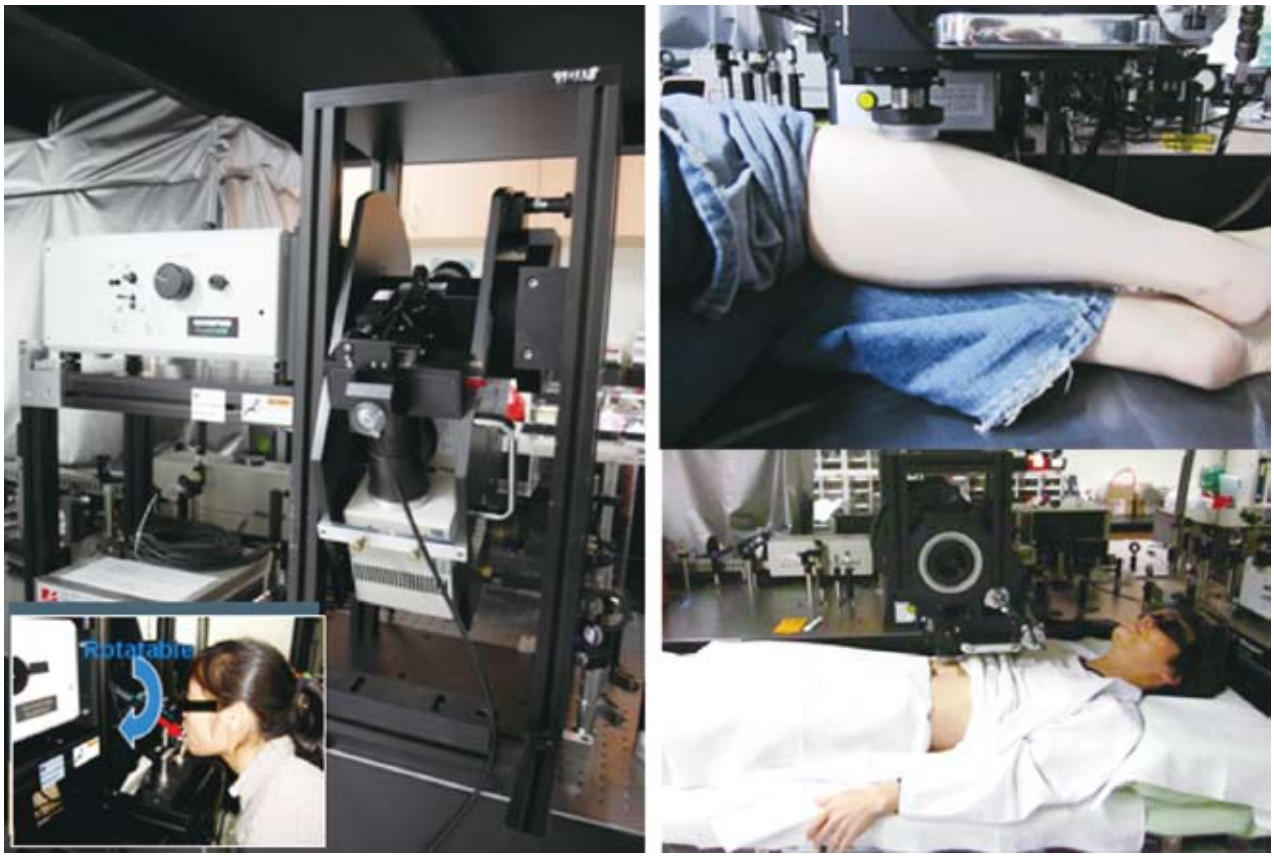
計畫名稱：倍頻式光學虛擬活體切片術
補助單位：國家衛生研究院
計畫期間：2010/01/01-2012/12/31

非線性光學顯微術主要是利用高尖峰功率的雷射脈衝在待觀察的生物體內所產生的非線性光學信號來成像。相較於傳統的螢光顯微術與共軛焦顯微術，非線性光學顯 微術只會在焦點產生足夠的光強度，因此先天上就具有優異的三度空間解析度，對生物體的傷害也較小，再搭配位於生物體穿透窗口的雷射光源（1200nm- 1300nm），可以大幅減少對生物體的光破壞，同時提升在生物體內的穿透深度，取得生物體內深層的”非侵入式”斷層切片影像。本實驗室的非線性顯微鏡，主要以二倍頻、三倍頻、以及多光子顯微鏡為主。二倍頻可以用來觀察生物體內的非中心對稱的結構，像是膠原蛋白纖維、肌肉纖維、神經管束…等等，三倍頻 則可以用來觀測生物體內各種組織與次細胞結構的型態，多光子螢光則是可以取得生物體內各種分子分佈的影像。我們以中心波長1230nm的飛秒鉻貴橄欖石雷射作為激發光源，以次細胞級的解析度，成功的在自願受試者身上進行不同皮膚疾病的活體觀察，包括良性及惡性的痣、基底細胞癌、鱗狀細胞癌及日光角化症。此外，我們亦將評估本系統在早期診斷糖尿病皮膚末梢神經病變，及分析良性及惡性組織含氧度上的可行性。作為未來臨床上的及時診斷系統。

Project title: Harmonics-based in vivo optical virtual biopsy
Supported by: National Health research Institutes
Project period: 2010/01/01-2012/12/31

Compared with traditional reflection/fluorescence confocal microscopy, nonlinear optical microscopy can avoid out-of-focus photo-damage and is with an intrinsically three dimensional sectioning capability. Combined with a laser source with an emission wavelength at the biological penetration window (1200-1300nm), it can further reduce photodamage and increase the penetration depth in live biological specimens. In our lab, we focus on the development of multimodal nonlinear microscopy combining second harmonic generation (SHG) and third harmonic generation (THG) signals, while minimizing the usage of multi-photon fluorescence

signals. SHG microscopy is generally used to observe non-centrosymmetric structures, THG microscopy is generally used to provide morphological information, and multiphoton fluorescence microscopy is generally used to provide molecular images. Based on a femtosecond Cr:forsterite laser with a central wavelength at 1230nm, in vitro and in vivo clinical trials have been conducted to solidify the system's capability and credibility for evaluating different cellular condition, structural protein distribution, and molecular morphology. These clinical studies ultimately will lay firm medical foundation for our HGM system to noninvasively identify and evaluate different diseases in the subclinical stage. Research topics include benign and malignant skin lesions, different types of skin carcinoma and actinic keratosis. The system capability in the early diagnosis of diabetic neuropathy and differentiating tissue oxygen level in benign and malignant lesions will also be studied.



倍頻式光學虛擬活體切片系統架構圖。

Version 1 and 2 are the implementation of the HGM system for in vivo imaging. The rotatable system is adapted from a commercial scanning system (FV300).

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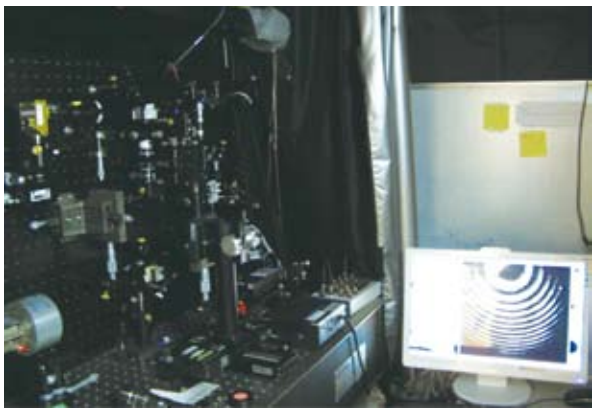
我們實驗室的研究方向是以光學方法來觀察生物組織、細胞與分子，主要分為各種光譜的分析以及光學影像系統的應用，以期對生物醫學領域的研究有所助益，並開發新的輔助醫學診斷的工具。長期的目標是針對疾病(特別是癌症)的早期徵兆，發展低侵入性的診斷儀器系統。

The research focus in our laboratory is to push forward the technologies of sensitive optical detection and imaging systems and utilize these systems to aid biomedical research and develop new diagnostic tools. The long-term objective is to develop minimally invasive diagnostic tools for early detection of disease such as cancer.



主要研究領域 Major Research Areas

生醫工程、生醫光電
Biomedical engineering, Biomedical Optics

研究計畫 Research Projects

1. 以結合光纖之高光譜影像術進行非侵入性癌前病變與癌症早期診斷
   Noninvasive early diagnosis of precancer and cancer using fiber-optic-based hyperspectral imaging
2. 癌症與癌前病變細胞之結構與其散射光特性之關連性研究
   Studying the relation between structure and light scattering properties of cancer/precancerous cells

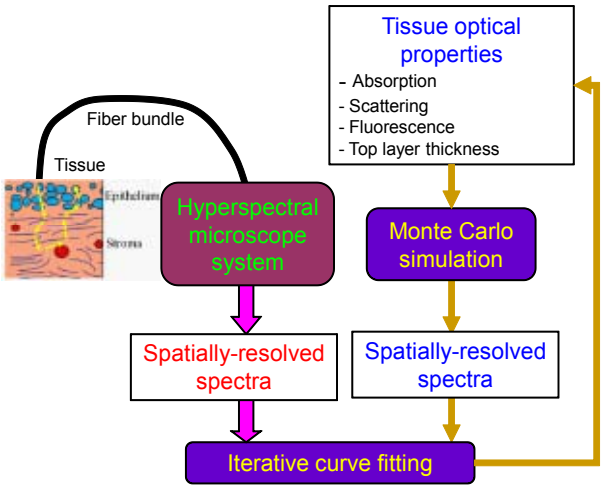
計畫名稱：以結合光纖之高光譜影像術進行非侵入性癌前病變與癌症早期診斷
補助單位：行政院國家科學委員會
計畫期間：2010/08/01-2013/07/31

本三年期研究計畫之目的是運用反射光譜與螢光光譜的技術，發展新穎的非侵入式癌(前)病變的早期診斷工具。現有的應用光譜進行非侵入式診斷主要有兩種方式，使用單點的光纖探頭測量組織局部區域的平均光譜，以及使用少數幾個特定波長的濾片來擷取大範圍的組織影像。本研究方法的優點在於結合光纖束與高光譜影像系統，可快速擷取組織上較大範圍內不同位置的光譜信號，因此同時具有兩種現有技術的優點，再利用蒙地卡羅數值模擬開發資料分析工具，將組織內不同深度的光學特性如散射、吸收與螢光強度定量，以輔助早期病灶之診斷。本計畫選定口腔與皮膚的癌(前)病變作為測試標的，由於組織的影像資訊是經由光纖束傳導到高光譜影像系統，不需要使用複雜且昂貴的微小化掃描機制造影，因此未來若使用與內視鏡的工作通道相容的光纖探頭，便可進一步將此技術廣泛應用在消化道黏膜上的早期癌病變檢查。我們將建構可移動的高光譜顯微影像系統，並使用具有跟組織的散射與吸收係數相近的仿體，驗證此系統測量到的光譜影像資料與組織光學參數的關係。然後將進行動物實驗，以致癌物誘發小鼠皮膚癌以及倉鼠口腔癌的動物模式，在致癌的不同階段收集光譜影像資料，並在測量的位置做組織切片以提供組織分層結構與病理診斷等資訊，協助開發與驗證用以分析組織深度與光學參數的工具。最後將進行先導性人體實驗，以評估此新穎儀器與資料分析方法作為輔助偵測癌(前)病變工具之可行性，並與現有方法比較其準確度。

Project title: Noninvasive early diagnosis of precancer and cancer using fiber-optic-based hyperspectral imaging
Supported by: National Science Council
Project period: 2010/08/01-2013/07/31

The objective of this proposed three-year project is to develop a novel non-invasive system based on reflectance and fluorescence spectroscopy for early detection of precancerous and cancer lesions. The major novelty of our approach is the hyperspectral imaging capability that enables simultaneous acquisition of spectra from hundreds to thousands of separated locations on tissue surface through an imaging fiber-optic bundle. Compared with existing point-probe optical spectroscopy systems,

the proposed method covers a larger area of tissue and has the ability to obtain depth-resolved tissue optical properties and fluorophore concentration for more accurate diagnosis. Compared with multispectral imaging systems developed for in vivo diagnosis, our approach has higher spectral resolution which facilitates extraction of tissue optical properties. We will build a movable hyperspectral imaging system incorporating an imaging fiber-optic bundle to relay the spatial information from tissue to the rest of the instrument, which eliminates the need to miniaturize the scanning mechanism so the probe can be made to be compatible with endoscopes. Reflectance and fluorescence spectra will be measured from tissue mimicking phantoms with known optical properties and geometry and validated with theoretical predictions obtained by Monte Carlo simulations. To investigate the feasibility of the proposed method to obtain diagnostically relevant tissue information in vivo, we will use animal models of oral and skin cancers to investigate the relation between dysplastic changes in tissue and the measured spectra. Monte Carlo-based data analysis methods will be developed to solve the inverse problem of obtaining tissue optical properties from measured spectra. Histopathologic information of the measured tissue sites will be provided as the gold standard for diagnosis. Finally, we will conduct pilot in vivo studies on the skin and the oral mucosa to determine whether the unprecedented spatial-spectral information can improve the discrimination between normal tissue, benign lesion, various degrees of dysplasia and cancer. We believe that successful completion of the research could lead to future development of a clinical tool which can detect the presence of epithelial precancer and provide information about the stage and the extension of the lesion.



代表圖及中英文說明：

組織光學參數量化流程：以結合光纖束之高光譜影像系統，擷取組織表面的漫反射與螢光光譜影像資訊，並與蒙地卡羅數值模擬工具得到的數據相比，達到組織光學參數之定量。

Flow of quantifying tissue optical properties: spatially-resolved reflectance and fluorescence spectra measured with a hyperspectral microscope system are fitted with Monte Carlo simulation results to estimate the tissue optical properties

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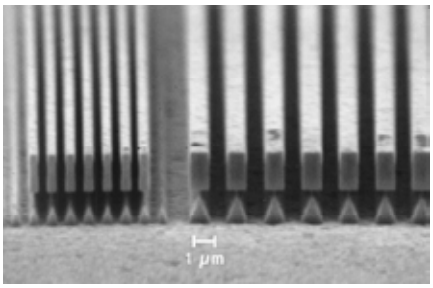
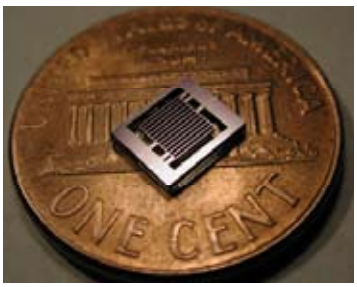
微奈米分析技術及系統實驗室
Micro/Nano Analytical Technologies & Systems Lab.

本實驗室由田維誠教授成立於2009年。本實驗室的研究方向為微奈米分析技術及系統在生醫檢測，醫療技術，及生物化學應用之研究。本實驗室的研究重心在微奈米機電、微奈米流體力學及有關元件系統整合、封裝及可靠性之研究，並希望與CMOS製程相結合。

未來將以微奈米分析技術及系統儀器出發，希望能大幅改進臨床前、臨床及體外診斷之準確性、速度、成本及使用方便性。

My research interests are on biological, chemical, and medical applications of micro & nano technologies with the focus on the CMOS compatible integration, packaging, and reliability of the micro/nano devices and systems. The future goal is to improve the accuracy, speed, cost, and ease-of-use of pre-clinical, clinical, and in vitro diagnostics by using micro/nano-enabled systems or instrumentations.





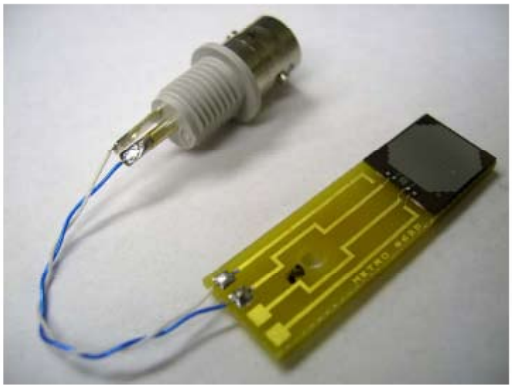
主要研究領域 Major Research Areas

微奈米分析及流體集成技術、微奈米機電系統儀器在生化醫療之應用

Micro and nano analytical & fluidic integrated technologies, MEMS/NEMS enabled instrumentation for biological, chemical and medical applications.

研究計畫 Research Projects

1. 人體呼吸氣體分析儀關鍵元件之研製與開發
   Research and Development of Key Components for Human Breath Analyzer
2. 混合式CMOS相容壓力微感測器陣列在非侵入血流監控之應用
   Mixed Mode CMOS-based Pressure Microsensor Arrays for Non-Invasive Hemodynamic Monitoring



計畫名稱：混合式 CMOS 相容壓力微感測器陣列在非侵入血流監控之應用
補助單位：行政院國家科學委員會
計畫期間：2010/08/01-2013/07/31

本三年期整合型計畫目標在於設計並且開發一整合型醫療系統。此醫療系統可以自動校準，並且以非侵入性的器材量測病患的脈波傳導速度並求得動脈血液流速。此參數是在近年來對於心血管疾病的診斷及治療相當程度的指標。本整合型醫療系統可以長時間並持續觀察病人的動脈血液流速，並藉此了解病人的身體狀況。

本子計畫將會提出數種以 CIC/TSMC CMOS MEMS 製程為基礎之微型壓力感測器，輔以適當之後製程(例如聚焦離子束奈米技術)，以陣列之型式提高脈波波型解析度。計畫初期將提出數種與 CMOS MEMS製程相容之新型微型壓力感測器設計（單一式），並且進行理論模型建構及後製程研發。接著將混合不同感測原理於單一感測器(混合式)，提供數種不同之物理量（如電容、電壓或頻率）來與壓力作關係，藉以提供一高效能之量測。

計畫中期將針對所研製之微型感測器陣列作設計實驗(DOE)以系統化之方法作析，期能以最佳化之設計展現其強大感測效能，並與下游端電路設計及信號處理子計畫相結合，以演算法分析以壓力感測陣列量取的人體皮膚壓力信號。計畫後期將會藉由廣泛的人體試驗蒐集實驗數據，並且根據實驗結果改進微型壓力感測器陣列之效能，特別是在封裝及與人體接觸之設計，希望能實現醫療器材產品化的初步整合。

Project title: Mixed Mode CMOS-based Pressure Microsensor Arrays for Non-Invasive Hemodynamic Monitoring
Supported by: National Science Council
Project period: 2010/08/01-2013/07/31

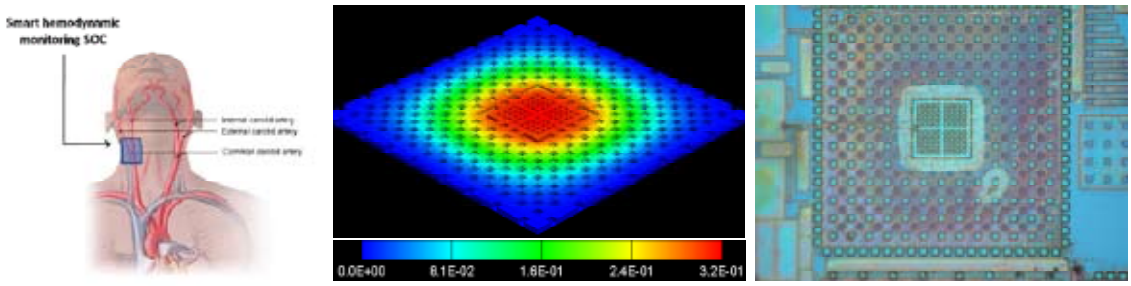
An integrated medical equipment system is proposed in this 3-year integrated project. This proposed medical equipment can be automatically calibrated to measure the patient's arterial blood flow rate based on the pulse pressure and pulse wave velocity (PWV). The blood flow rate is an important indicator in the treatments of cardiovascular diseases nowadays. The proposed integrated medical equipment can monitor the blood flow of the patients continuously for a long period, and the condition of the patients can be evaluated by analyzing the collected data.

The main research goal for this subproject is to develop the sensor array for this integrated medical equipment. This high-resolution sensor array will be highly sensitive, robust, and accurate for precise pulse pressure measurement required to obtain accurate blood flow rate.

Several micro-electro-mechanical systems (MEMS)-based pressure sensors, which are compatible with CMOS MEMS process, will be proposed in this subproject. Few post-processes, e.g. Focused Ion Beam (FIB) nano technology, will be designed and implemented after CMOS MEMS process to complete our sensors' fabrication. We propose to combine various transduction mechanisms (e.g. resistance change, capacitance change, voltage change, or frequency change) into one sensor to provide an orthogonal sensing platform to further enhance the sensitivity, robustness, and accuracy of the pulse pressure measurement. These mixed mode sensor arrays will be used to better increase the spatial resolution of the system to get a better mapping of pulse wave pressure.

In the beginning of this project, several CMOS MEMS-based pressure sensors, with numerous sensing and driving mechanisms, will be designed and modeled. The optimal designs (both single mode and mixed mode) will be chosen based on a systematical evaluation (tradeoff matrix). Next, these optimal designs, in parallel with the development of interface circuits and signal process & algorithms, will be submitted to CMOS MEMS line. With properly post-treatments after receiving the CMOS MEMS chips, all these chips with different designs will be tested and evaluated based on the design of experiments (DOE). These single and mixed mode sensors will be evaluated individually to get device characteristics and also be tested to obtain the pulse pressure from human skin. The final part of this project is to work with other sub-teams to implement a prototype to collect the human clinical data. Based on the developed human hemodynamic model and initial collected clinical data, enhancement and improvement of the sensor array implementation, such as sensor array packaging, human-sensor array interface, or different designs, will be performed to obtain a working prototype for future commercialization.

代表圖及中英文說明：



左圖：系統晶片在非侵入血流監控之應用示意圖
中圖：有限元素分析法模擬結果。本圖顯示觸覺壓力感測器薄膜經由外在壓力100mmHg後之形變。
右圖：經由CMOS MEMS製程製作而成之觸覺壓力感測器。
Left: The conceptual design of a smart hemodynamic monitoring SOC
Middle: Finite element modeling results.
The displacement of a pressure sensor membrane upon an applied force of 100 mmHg
Right: The photo of a pressure sensor cell fabricated by the CMOS MEMS process

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Digital Signal Processing Lab.

主要研究領域 Major Research Areas

一、生醫訊號處理

1. 超音波：對比劑的研究和利用，計算經由對比劑回波訊號中的諧波成分來估測理論中組織的衰減係數，其中必須利用周期譜的方式求得訊號的功率頻譜密度。設計一個可用在體內實驗的適應性演算法，用以估測體內組織的衰減係數。並且，對此法做誤差分析以得知應用此方法估測衰減係數與理論值的差距。利用動物實驗，將不同程度的肝臟疾病應用超音波對比劑在肝組織的分佈情形藉以判斷肝病。
2. 胎兒心電圖：胎兒心電圖的觀察有實際上的困難，因為胎兒位於母體之內，皮膚上的電極所紀錄的信號中，同時存在兩個本質上相同的來源，為母親和胎兒的心臟。尤其母親心電圖的信號強度遠大於胎兒心電圖，更增加了處理上的困難。另外，因為胎兒心電圖十分微弱，其他生理現象所產生的干擾或是量測上造成的雜訊，相對於胎兒心電圖的影響也會十分顯著。本研究著力於胎兒心電圖的信號取得。
3. 腦波

二、水下通訊

水聲通訊和無線電通訊主要有二個最大的差異點，一是水聲通道有非常長的多重路徑延遲，範圍可涵蓋十到一百多個符號(symbols)，另一個是通道時變的速度。對於基於通道估測的等化器來說，通道估測是決定其效能的表現的最重要因素。

- Diagnostic Medical Ultrasound: Ultrasound Contrast Imaging, Ultrasonic Liver Imaging
- Bio-signal Processing : Fetal ECG extraction, EEG Signal Analysis
- Underwater Acoustic Communication: UWA Channel Estimation, Tracking and Equalization

研究計畫 Research Projects

1. 超音波對比劑於組織參數估測之應用(1)
2. 超音波對比劑於組織參數估測之應用(2)
3. 一個用於二次諧波脈衝壓縮成像之多頻合成技術

計畫名稱：超音波對比劑於組織參數估測之運用
補助單位：行政院國家科學委員會

對於生物組織的超音波反應特性而言，衰減係數是個重要的參數。一般估測組織的衰減係數大略可分為利用背散射訊號估測以及穿透訊號估測兩種。其中，背散射訊號的估測方式可適合於大部分的應用。但是卻有散射成份干擾的困難。應用穿透訊號的方式是較為適合於估測衰減係數，但是由於必須在組織兩端皆放上探頭，因此只適合體外實驗用。近年來由於超音波對比劑的的技術成熟，使得我們可以發展一個新方法，使用對比劑來估測體內組織的衰減係數。由於對比劑有高度非線性的特性，因此我們藉由使用多組頻率激發組織之後的對比劑，我們可應用其所產生的諧波訊號達到應用穿透訊號估測組織衰減係數的目的。除此之外，我們也應用對比劑在肝組織當中的分佈比率估測肝組織整體的健康程度。

在本計劃中，我們將研究分成三個部份來進行研究：（一）我們計算經由對比劑回波訊號中的諧波成分來估測理論中組織的衰減係數，其中必須利用周期譜的方式求得訊號的功率頻譜密度。（二）設計一個可用在體內實驗的適應性演算法，用以估測體內組織的衰減係數。並且，對此法做誤差分析以得知應用此方法估測衰減係數與理論值的差距。（三）利用動物實驗，將不同程度的肝臟疾病應用超音波對比劑在肝組織的分佈情形藉以判斷肝病。

Attenuation Coefficient (Att. Coef.) is an acoustic parameter for tissue characterization. Two major techniques for Att. Coef. Estimation are the backscattering and transmission methods. Backscattering method is suitable for general applications, but the speckle interference makes it inaccurate. Transmission method is more reliable, but it is suitable for peripheral organs only, due to the need of a separate transmitter. With the aid of contrast agent (microbubble), a new way to estimate the Att. Coef. of soft tissues is proposed, which is suitable for general applications . Since microbubble is a highly nonlinear object, Using the multiple frequencies generated by microbubbles behind the tissue, the Att. Coef. Can be estimated in transmission mode. Since the harmonics are generated by common microbubbles, their relative strengths can be predicted by theory and measured for Att. Coef. Estimation.

The research is divided into three parts. First, we use periodogram to estimate the power spectrum of echo signals and using the second harmonic component to estimate the theoretical Att. Coef. Secondly, we will develop an adaptive algorithm to estimate Att. Coef. Which is suitable for general application. Finally, we use agent distributed in different rates to estimate liver diseases.

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生物資訊與化學資訊實驗室
Bioinformatics and Cheminformatics Lab.

本實驗室是一個跨領域的實驗室，研究的方向有兩個主軸，一是以分子結構為中心探討分子結構與活體、活性、毒性之關係，包括計算化學用在藥物設計、計算毒理學、化學資訊、生物資訊及代謝體學等，本實驗室應用物理化學、數值分析及資訊統計的技術來解決各種生物、化學及醫學方面的問題。目前主要的研究包括1. 發展新的計算化學方法做為臨床前藥物吸收、分佈、代謝及毒性之分析及新藥設計。2. 以化合物三維結構分析用在化學資料庫做虛擬藥物篩選與化學結構資訊比對。 3. 應用代謝體之化學結構光譜找尋臨床上用來做為診斷、病程及癒後生物指標之結構及新藥設計。

另一主軸則是運用台灣特有之健保資料庫來分析台灣藥物使用之各種問題及行為模式等。此外，本實驗室亦與其他相關藥物設計、分析、合成團隊共同執行國內外各項藥物開發之研究計畫。

Bioinformatics and Cheminformatics Laboratory is a multidisciplinary lab. There are two main research themes in this lab. First and the major one is to analyze molecular structures such as drugs, endogenous molecules, proteins, and relate the structure for their pattern with biological activities, toxicities, and biological systems in the field of computational chemistry, computational toxicology, bioinformatics, cheminformatics, and metabonomics.

The other major theme is to use National Health Insurance Research database to perform analysis in prescription usage, prescribing pattern of medical personal, related policy impact and health behavior. We collaborate closely with pharmaceutical companies, drug synthesis groups, and drug analytical groups to conduct drug discovery research.

主要研究領域 Major Research Areas

計算化學及計算毒理學、生物資訊學、化學資訊學、醫學資訊學
Computational Chemistry and Computational Toxicology, Cheminformatics, Bioinformatics, and Medical Informatics

研究計畫 Research Projects

1. 三維結構模式生物資料庫的快速檢索
   3D conformational structure patterns for fast bioinformatics database searching
2. 乳癌治療抗療性之整合研究--以aptamer之電腦模擬篩選(In silico)平台發展抑制血管新生抗乳癌藥物（子計畫一）
   In Slico aptamer platform for anti-angiogenesis on breast cancer (subproject 1 of Integrated approach to dissecting resistance of anti-cancer treatment in breast cancer)
3. 結構最佳化計算暨臨床前結構安全性篩選
   In Silico Lead Optimization and Preclinical Safety Screening

計畫名稱： 結構最佳化計算暨臨床前結構安全性篩選
補助單位： 行政院國家科學委員會(生物處)

本計畫是為生技製藥國家型科技計畫建構電腦藥物篩選平台來為神經保護劑與治療神經病變性疼痛化合物、抗血栓化合物、抗血管內皮生長因子受體系列化合物、以及TW01 類似物之先導化合物的優化（lead optimization），進行一系列的模擬篩選，以了解其定量構效關係，並設計優化結構以增強其活性及降低毒性。

計畫內容:

首先，關於神經病變性疼痛化合物，我們已經開發一套新平台，從已知與神經病變性疼痛有關的抑制劑結構中進行拆解，置換抑制劑結構中能量較低或化學性質不佳者的抑制劑子結構，以合成出更有效的抑制劑。關於抗血栓化合物，我們已將這一系列的化合物的RI-QSAR(與受體無關之構效關係)模型進行改良，將更有機會提供其他具有同樣效用的化合物做為其開發的參考。在TW-01的部分，我們將structural interaction fingerprint的模型進行系統的改良，同時把這幾年來做的model及分析做了整理及討論，將這一系列分子於receptor上作用位置的差異主要在何處做了更為完整的說明。為抑制VEGFR-2與VEGFR-3受體，一套以片段為主的新藥設計系統架構已建構完成，目前可合成出sorafenib、nilotinib、aminoisoquinolin系列化合物來作為驗證本系統的一項重要依據。

主要成就與成果價值

(1) 代表性重要論文:

Su, B.-H.; Shen, M.-Y.; Esposito, E. X.; Hopfinger, A. J.; Tseng, Y. J., In Silico Binary Classification QSAR Models Based on 4D-Fingerprints and MOE Descriptors for Prediction of hERG Blockage. J. Chem. Inf. Model. 2010, 50 (7), 1304–1318.

(2) 技術服務項目:

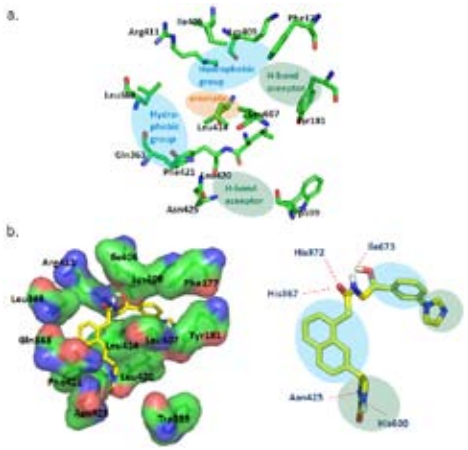
已將hERG毒性預測平台系統化，成為本實驗室可供對外幫助測試之服務項目。

(3) 重大專利項目:

與孫仲銘教授合作新合成之抗血管內皮生長因子受體化合物，經郭明良教授實驗室測得具有活性，成功發現結構全新的先導藥物 -nstpbp000194，這個化合物可以明顯抑制VEGFR3活性，進而抑制人類淋巴內皮細胞之增生及移動，是具抗癌潛力之藥物，並在民國九十七年十二月三日正式申請新物質專利 (US 11/949070; PCT/US07/86220)。之後交大孫仲銘教授在今年完成了另一結構新穎的先導藥物-NCTU-SUN-253及此類化合物之分子庫的合成，此藥物具有全新的化學結構，且此類化合物在VEGFR3的系統中有著比nstpbp000194更佳的抑制活性，並以著手進行professional patent的申請，另外也同時進行先導藥物 -nstpbp000194的最佳化，經由曾宇鳳老師的4DQSAR摹擬系統，以及期刊論文的收尋，和長久以來的經驗，終於在最近發展出與上市藥物抑制活性相當的藥物 -NCTU-SUN-565，此類衍生物在細胞測試及動物測試上都有顯著的效果，且改善了原本溶解度不佳的問題，並已保護在194的專利之下 (US 11/949070; PCT/US07/86220) 專利申請方面，已過國內專利一篇、歐美專利四篇，並且已進行技轉之洽商。

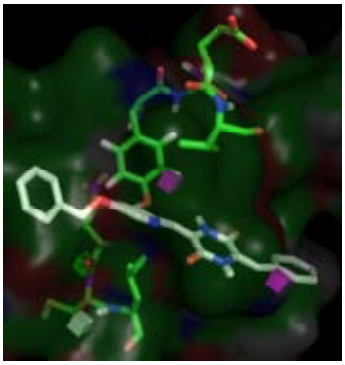
(4) 技術創新項目:

(A) 在神經病變性疼痛化合物的設計方面，我們利用合作實驗室研究團隊提供之一系列先導化合物，結合lipoxygenase結構資訊，分析先導化合物的子結構並組合出具有不同子結構之新分子，更優化原始之先導化合物。我們已提供一系列初步篩選的分子，提供合作的研究團隊做實驗分析。初步篩選的分子與lipoxygenase 蛋白質活性區的作用結構如圖一。



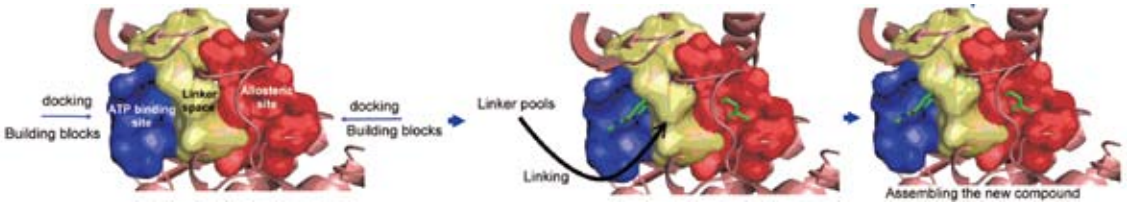
圖一 a. Lipoxygenas活性區之特徵分析。b. 初步篩選的分子與lipoxygenase 蛋白質活性區的作用結構。

(B) TW01建立基於結構的構效關係模型：

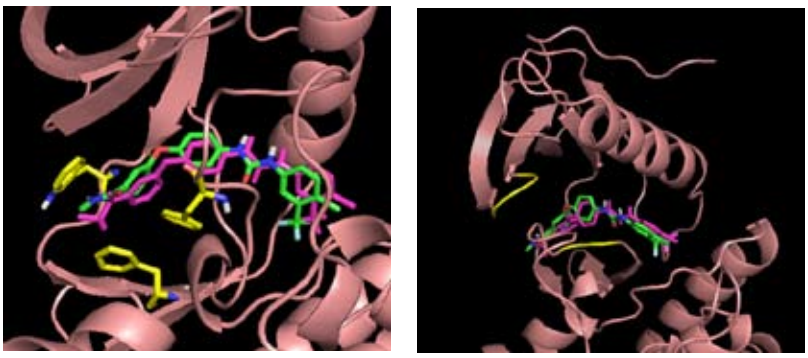


圖二. 在Abl這個激脢中位於Tyr253~Val256和Asn368~Leu370附近的胺基酸，對於活性似乎有決定性的影響，在其他的模型中，我們也發現類似的特性。

(C) 為發展抗血管內皮生長因子受體系列化合物，建構一套以片段為主之新藥設計系統。



圖三. 以片段為主的新藥設計系統架構圖



圖四. 利用以片段為主的新藥設計系統，重新建構出來之sorafenib與Braf之結合位置作為驗證的重要依據。

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王水深 教授 *Wang, Shoei-Shen,* Professor

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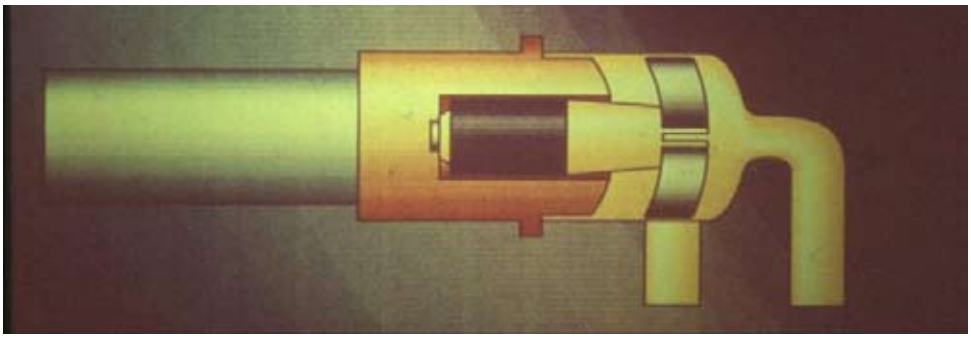
國立臺灣大學附設醫院心臟移植及心肺移植 召集人

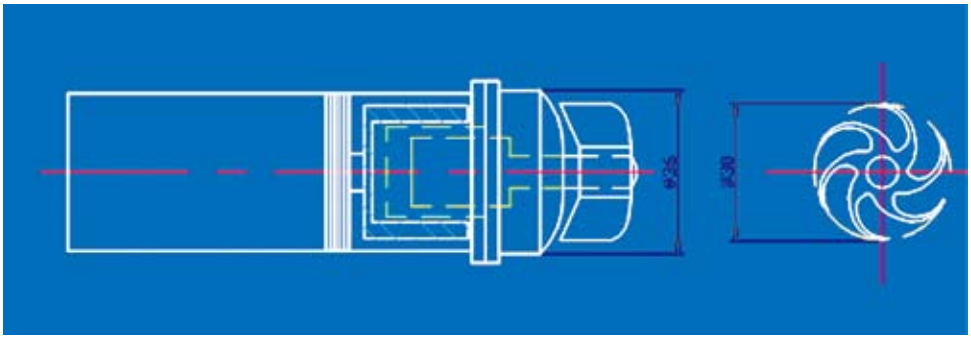
Professor, Graduate Institute of Biomedical Electronics and Bioinformatics/ Division of Cardiovascular Surgery, National Taiwan University
Director, Heart Transplantation and Heart-Lung Transplantation, National Taiwan University Hospital

心臟輔助器實驗室
Ventricular Assist Device Lab.

自1993年我們就積極研究流線型離心幫浦做為心臟衰竭的輔助循環，可在100mmHg阻力下提供8 L/min的輔助。而利用電壓的改變而改變葉輪的轉速造成博動流。包含馬達的總重量只有110g，總長度只有7 cm，溶血系數只有0.020。此心臟輔助器擁有經濟部智慧財產局新型第一五四一O五號及新型第M323290號專利。目前我們持續研究小而美的心臟輔助器以供幼兒使用。

We started to develop our own centrifugal pump with streamlined design in impeller type in 1993. It can produce 8L/min output at a resistance of 100 mmHg. It can provide pulsatile flow by changing the rotating speed of the impeller periodically via introducing a square wave form voltage into the driving motor coil of the pump. Together with the generator, it weighs only 110 gm with a total length of 7 cm, and index of hemolysis of only 0.020. Now we keep on developing a smaller pump to treat the intractable heart failure for infants.





臺大一號心室輔助器

主要研究領域 Major Research Areas

- 心臟外科包括冠狀動脈繞道手術、瓣膜手術、主動脈手術、心律不整手術、心臟衰竭手術等
- 血管外科包括胸主動脈瘤支架或手術、腹主動脈瘤支架或手術、周邊動脈阻塞重建手術、靜脈曲張手術、尿毒症血液透析之廔管手術等
- 心臟輔助循環包括葉克膜體外維生系統、心室輔助器等
- 移植手術包括心臟移植、心肺移植
- Cardiac Surgery：Coronary Artery Disease Surgery, Valvular Heart Disease Surgery, Aortic Surgery, Arrhythmia Surgery, Surgery for Heart Failure
- Vascular Surgery：EndoVascular Stent-grafting for Thoracic Aortic Aneurysm or Abdominal Aortic Aneurysm, Revascularization for Peripheral Arterial Occlusive Disease, Varicose Vein Surgery, Arteriovenous Fistula Creation
- Mechanical Circulatory Assist：Extracorporeal Membrane Oxygenation, Ventricular Assist Device
- Transplantation：Heart Transplantation, Heart-Lung Transplantation

研究計畫Research Projects

1. 台大心室輔助器導管組織化之研發：Poly(ε -caprolactone)(PCL)- Chitosan表面奈米化對細胞成長之效應
(國科會計畫NSC94-2314-B-002-122, 2005/08/01 ~ 2006/07/31)
Taita left ventricular assist device application for tissue-engineering :
surfaces technique could enhance the growth of cells and application for tissue engineering.
(NSC94-2314-B-002-122, 2005/08/01 ~ 2006/07/31)

2. 一項為期6個月、多中心、隨機化、開放性的研究，其目的在評估Certican加類固醇並加上二種劑量的Neoral在新的心臟移植患者的安全性、耐受性及有效性
(台大醫院計畫, 2006 ~ 2009)
A six-month, multicenter, randomized, open-label study of the safety,tolerability and efficacy of two Neoral doses in addition to Certican and steroids in de novo heart transplant recipients.
(NTUH, 2006 ~ 2009)

3. 骨髓間葉幹細胞於心肌再生的研究：組織工程支架與骨髓間葉幹細胞的分化 ，一、材料的修飾 二、不同的生長與分化環境
(國科會計畫NSC95-2745-B-002-006, 2006/08/01 ~ 2007/07/31)
Regenerating myocardial cells by using mesenchymal stem cell(MSC)-the effect of a.different scaffold surface material, b.different growth and differentiation environment on the differentiat of MSC within tissue engineering scaffold.
(NSC95-2745-B-002-006, 2006/08/01 ~ 2007/07/31)

4. 正位心臟移植手術其術後身體活動度與心率變異度相關性之探討
(台大醫院計畫, 2006 ~ 2009)
The relationship between physical activity and heart rate variability in orthoropic heart transplant recipient.
(NTUH, 2006 ~ 2009)

5. 人體心肺移植
(台大醫院計畫, 2006 ~ 2010)
Heart-lung transplantation.
(NTUH, 2006 ~ 2010)

6. 一項為期24個月、多中心隨機分配、開放性、非劣性的研究，比較在兩個濃度控制的Certican併用降低劑量的Neoral對照3克的MMF併用標準劑量的Neoral於新接受心臟移植病患者的療效與安全性
(台大醫院計畫, 2006 ~ 2011)
A 24-month, multicenter, randomized, open-label non-inferiority study of efficacy and safety comparing two exposures of concertration-controlled Certican with reduced Neoral versus 3.0g MMF with standard dose Neoral in de novo heart transplant recipients.
(NTUH, 2006 ~ 2011)

7. 人類心臟幹細胞之分離與鑑定
(台大榮總兩院合作計畫NTUH.96VN-004, 2007/01/01 ~ 2007/12/31)
Identification and characterization of human cardiac stem cells.
(NTUH.96VN-004, 2007/01/01 ~ 2007/12/31)

8. 不同製備方式評估蠶絲支架(scaffold)及不同的表面修飾對骨髓間葉幹細胞的體外心肌細胞分化與動物植入心肌再生實驗
(國科會計畫NSC96-2314-B-002-043, 2007/08/01 ~ 2008/07/31)
Effect of different surface modifications and fabrication techniques of silk fibrion-based scaffolds on differentiation of MSC into myocardiocytes in vitro, and on regenerating myocadiacytes in myocardial infarction(MI) rats.
(NSC96-2314-B-002-043, 2007/08/01 ~ 2008/07/31)

9. 骨髓間葉幹細胞於心肌再生的研究：評估不同製備方式評估蠶絲移植物對骨髓間葉幹細胞分化影響與動物實驗(1,2,3)
(國科會計畫NSC97-2314-B-002-045-MY3, 2008/08/01 ~ 2011/07/31)
Regenerating myocardial cells by using mesenchymal stem cell(MSC)- effect of different fabrication techniques of silk fibrion-based scaffolds on differentiation of MSC into myocardiocytes in vitro, and aminal study(1,2,3).
(NSC97-2314-B-002-045-MY3, 2008/08/01 ~ 2011/07/31)

10. 幹細胞於心肌再生的研究：評估蠶絲移植物對幹細胞分化影響與動物實驗
(台大醫院院內計畫98 -S1079, 2009/01/01 ~ 2009/12/31)
Regenerating myocardial cells by using stem cell-silk fibrion-based thin film on differentiation of stem cell into cardiomyocytes in vitro, and animal study.
(NTUH 98 -S1079, 2009/01/01 ~ 2009/12/31)

11. 運動處方對國人重大疾病的健康效益－臨床與代謝體指標的探討－「運動處方對於冠狀動脈繞道手術病患的健康效益：臨床與代謝體指標的探討(子計畫四) (1/3,2/3,3/3)
Discussion of the health benefits on exercise prescription of major disease – the benefits of exercise prescription for coronary bypass patient – discussion of clinical and metabonomics
(NSC100-2627-B-002-018, 2010/08 ~ 2013/07)

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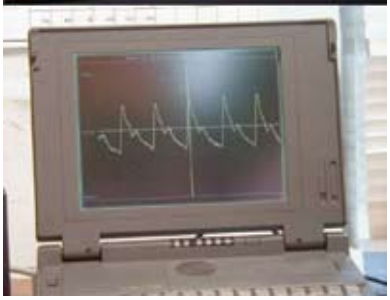
非侵入式生理量測實驗室
Non-Invasive Physiological Measurements Lab.



非侵入式生理量測實驗室，其主要乃以科學之方法來進行中醫在疾病診斷、治療以及保健等原理與其可行部份之驗證研究；以及利用非侵入方式量測生理參數如血糖、血氧等。

近幾年來，實驗室在王唯工老師的帶領下，所進行的研究如下：

1. 脈診分析理論在臨床診斷之應用：
   在此項中，早於民國81年即已完成脈診儀的原型儀器(Prototype)，進行以脈診儀協助中醫診斷的可行性研究；進而將之應用於中藥的方劑作用分析；再進一步針對血壓波及微循環血流波頻譜的交互關聯做更深入地探討。將其用之於臨床疾病診斷的評估及應用。
2. 非侵入式生理參數量測：
   近年來，實驗室研究以非侵入方式量測血液中成份，包括血糖、血氧。

Non-invasive physiological Laboratory was founded by Professor Wang Wei-Kung with the main research focus in Pulse-feeling and foundation of Chinese medicine and non-invasive means to study blood ingredients, such as Glucose, Oxygen. In the past few years, we have conducted a number of research projects in the following:

1. Applications of Pulse-feeling in clinic diagnosis
   We had finished the prototype of pulse diagnosis system in 1992. We used the pulse diagnosis system to assist diagnosis of Chinese medicine and analyze the mechanism of Chinese herbs. And research focus in the relationship between pressure pulse and spectrum of microcirculation and applications of Pulse-feeling in clinic diagnosis.
2. Non-invasive means to study blood ingredients
   In the past few years, we used the non-invasive means to study blood ingredients, such as Glucose, Oxygen.

主要研究領域 Major Research Areas

非侵入性式生理量測
Non-invasive physiological measurement

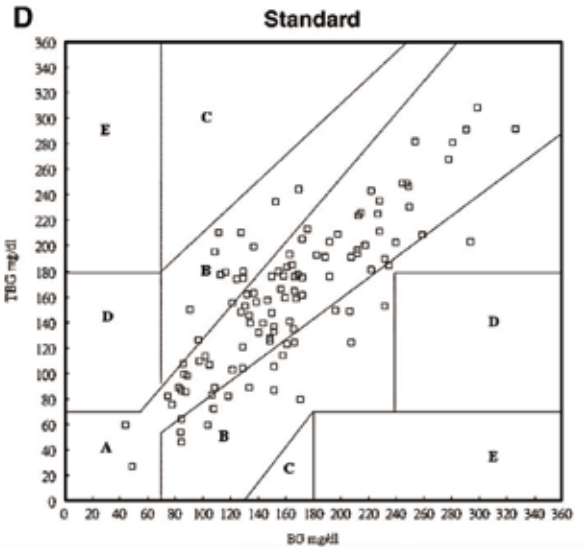
研究計畫 Research Projects

1. 非侵入性生理量測血液成份如血糖、血氧
   Non-invasive means to study blood ingrediences. Such as Glucose, Oxygen
2. 中醫基礎與脈診研究
   Pulse-feeling and fundation of Chinese medicine
3. 減少二氧化碳產生之食品與塑身研究
   Food to reduce CO2 production and body Casting
4. 遠距醫療服務之研究
   How to provide these services through Web

計畫名稱：非侵入式血糖監視儀
補助單位：Tangtest股份有限公司
計畫期間：2010 - 2017

研究並改進Tangtest非侵入式血糖監測儀，包括其軟硬體的修改與臨床試驗的程序。相關成果論文發表於Journal of Diabetes and Its Complications doi:10.1016/j.jdiacomp.2007.03.011

代表圖及中英文說明：



Y軸為非侵入血糖監測儀所量測數值，X軸為一般採血血糖值。113資料點全落於Clarke error grid中A、B區。其線性關係(r=.81; slope=0.82; intercept=28.0)
The y-axis represents measurements from the TG (TBG), and the x-axis represents measurements from the fingerstick blood glucose meter (BG).The 113 data points with correction of both the position and P criterion, of which 100% fell within Zones A and B in the Clarke error grid. Data in Zones A and B exhibit a linear relationship (r=.81; slope=0.82; intercept=28.0) between noninvasive and fingerstick measurements.

Project title: Non-invasive blood glucose monitoring
Supported by: Tangtest Co. USA
Project period: 2010-2017

The objective of this study was to determine the conditions for optimizing measurements obtained with a noninvasive blood glucose monitor using the optical signal of pulsatile microcirculation (OSPM) in both prediabetic and diabetic subjects receiving medication. Research design and methods: Eighteen subjects (3 prediabetic, 15 diabetic) aged 61.8 [15.9] years (mean [S.D.]) were studied. OSPM was the pulsatile component (P) of the signal obtained and analyzed by a blood glucose monitor. The measurement was calibrated to the fingerstick meter for each subject for personal calibration. Data were obtained from all subjects using both meters. Results: A total of 179 data pairs were measured and analyzed. The validity of the position of the tested finger was assessed using the position criterion, which

resulted in the removal of 38 data pairs. The criterion for the intensity of the P signal was satisfied by 141 data pairs, with nonconforming data (with a much lower P signal) mainly occurring below 26℃. A total of 113 data points passed both criteria, and 100% of them fell within Zones A and B of the Clarke error grid. Data in Zones A and B exhibited a linear relationship (r=.81; slope=0.82; intercept=28.0) between noninvasive and fingerstick measurements. Conclusions: Environmental temperature has the greatest influence on the capability of the OSPM technique to monitoring blood glucose concentration, which is subject dependent. The position of the tested finger is the second major factor, hence a carefully designed finger adaptor is essential.

Journal of Diabetes and Its Complications doi:10.1016/j.jdiacomp.2007.03.011

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臨床磁振影像實驗室
Clinical Magnetic Resonance Imaging Lab.

本實驗室由吳文超教授成立於2010年，主要從事磁共振影像技術開發與臨床應用之相關研究，目前以微灌流影像與功能性影像為研究重點，並與台大醫院影像醫學部、核子醫學部合作，建立多模技術平台，提高於臨床診斷及預後的準確性。

Professor Wen-Chau Wu founded the Laboratory of Clinical Magnetic Resonance Imaging in the summer of 2010. The main research focus has been placed on the technical development and clinical applications of magnetic resonance imaging (MRI). Currently, we are conducting three NSC funded projects using advanced MRI techniques, including multi-modal functional MRI, perfusion MRI (arterial spin labeling, dynamic susceptibility contrast enhanced imaging, and dynamic contrast enhanced imaging), and diffusion-weighted MRI. We closely collaborate with the Departments of Medical Imaging and Nuclear Medicine in National Taiwan University Hospital to build up a multi-modal framework to improve the accuracy of diagnosis and prognosis in various diseases.

主要研究領域 Major Research Areas

微灌流磁共振影像、功能性磁共振影像、醫學影像處理、生醫信號分析
Perfusion Magnetic Resonance Imaging (Arterial Spin Labeling and Bolus Tracking), Functional Magnetic Resonance Imaging, Medical Image Processing, Biomedical Signal Analysis

研究計畫 Research Projects

1. 速度選擇動脈氫質子標記法微灌流磁振造影
   Velocity-selective arterial spin labeling perfusion magnetic resonance imaging
2. 四肢肌肉之功能性磁振造影
   Functional magnetic resonance imaging in extremity muscles
3. 使用動態對比劑增強及動脈標定磁振造影技術定量腎臟血流灌注並評估臨床應用之可行性
   Clinical feasibility of dynamic contrast enhanced MRI and arterial spin labeling MRI in quantitative assessment of renal perfusion

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我們主要研究工作有下列四方面（1）找尋國人肺癌之危險基因。（2）建立體外癌轉移模式，全基因體搜尋癌轉移相關基因。（3）發現新的癌轉移基因及機轉做為診斷及治療標的。（4）研究癌細胞與周邊微環境之交互作用，特別是發炎細胞與癌細胞的互動。我們以cDNA基因微陣列研究基因之調控，訊息傳遞及功能。在基因流行病學研究我們已找到數個國人肺癌之危險基因，我們更以自己建立之肺腺癌之細胞株，利用侵襲篩選之細胞培養方式，篩選出高侵襲能力之子細胞株，並在老鼠實驗動物模式證明高侵襲肺癌細胞株也同時具有高轉移能力，利用以一體外模式及cDNA微陣列，我們可以全基因體找尋癌轉移之相關基因，在含9600基因之微陣列中我們找到近600個基因與肺癌轉移有關，我們將利用這些基因製成癌轉移檢測晶片推廣至臨床使用。同時在這些癌轉移相關基因中，我們發現新的抑癌轉移基因及促癌轉移基因如Collapsin Response Mediator Protein-1 (CRMP-1)，LCRMP-1，HLJ1及Slug等。這些基因在癌轉移之分子調控機制為目前主要研究之重點，且此類新的癌轉移相關蛋白也成為治療主要標誌分子，我們也用基因微陣列之研究模式，剖析這些基因之下游基因。最近，我們正著重於研究這些新的癌轉移相關蛋白之訊息傳遞途徑及功能和蛋白交互作用機制。

Our research teams are interested in studying the molecular pathogenesis of lung cancer in Taiwan and mechanisms of cancer metastasis. We focus on four aspects: (1) identification of novel risk genes for lung cancer in Taiwan, (2) molecular signature for prognostic prediction and personalized therapy of lung cancer, (3) identify novel genes and mechanisms involved in cancer metastasis for potential diagnosis and treatment targets, and (4) interaction of cancer cells and microenvironments, especially the cross talks between cancer cells and microenvironment inflammatory cells. Our team has identified several candidate risk genes for lung cancer. Cancer metastasis is a complicated

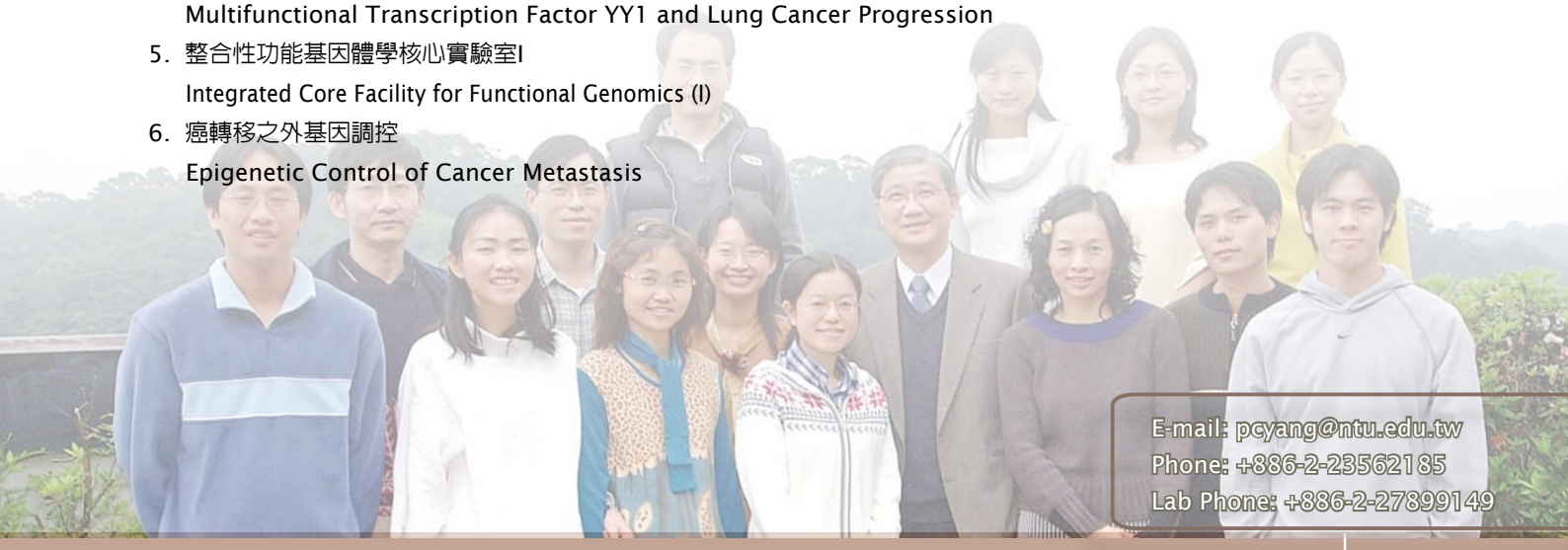
process that may involve numerous genetic changes. To identify invasion/metastasis associated genes, we used DNA microarray and invasion/metastasis lung cancer cell line model and identified a panel of genes associated with lung cancer metastasis. We also developed gene expression signature and microRNA signature that can predict survival and metastasis of lung cancer patients. These molecular signatures may be helpful for personalized therapy of lung cancer patients. We have also identified novel invasion/metastasis suppressor genes such as collapsin response mediator protein-1 (CRMP-1), long form CRMP, HLJ-1 and invasion promoting gene slug. Currently, we are investigating the molecular mechanisms and signaling pathways and protein interaction maps of these novel metastasis related genes.

主要研究領域 Major Research Areas

基因體醫學、細胞生物學、轉譯醫學
Genomic medicine, Cell Biology, Translational Medicine

研究計畫 Research Projects

1. 探討HIPK2與Slug在致癌性及癌轉移的角色
   HIPK2 regulates slug-mediated tumorigenesis and metastasis
2. 研究促癌轉移基因 Slug 在細胞週期扮演的角色
   The invasion promoter Slug is a novel cell cycle regulator
3. 整合性功能基因體學核心實驗室II
   Integrated Core Facility for Functional Genomics (II)
4. 多功能轉錄因子YY1和肺癌生成關係之探討
   Multifunctional Transcription Factor YY1 and Lung Cancer Progression
5. 整合性功能基因體學核心實驗室I
   Integrated Core Facility for Functional Genomics (I)
6. 癌轉移之外基因調控
   Epigenetic Control of Cancer Metastasis



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發表論文 Publications

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