國立臺灣大學
生醫電子與資訊學研究所

Graduate Institute of
Biomedical Electronics and Bioinformatics,
National Taiwan University

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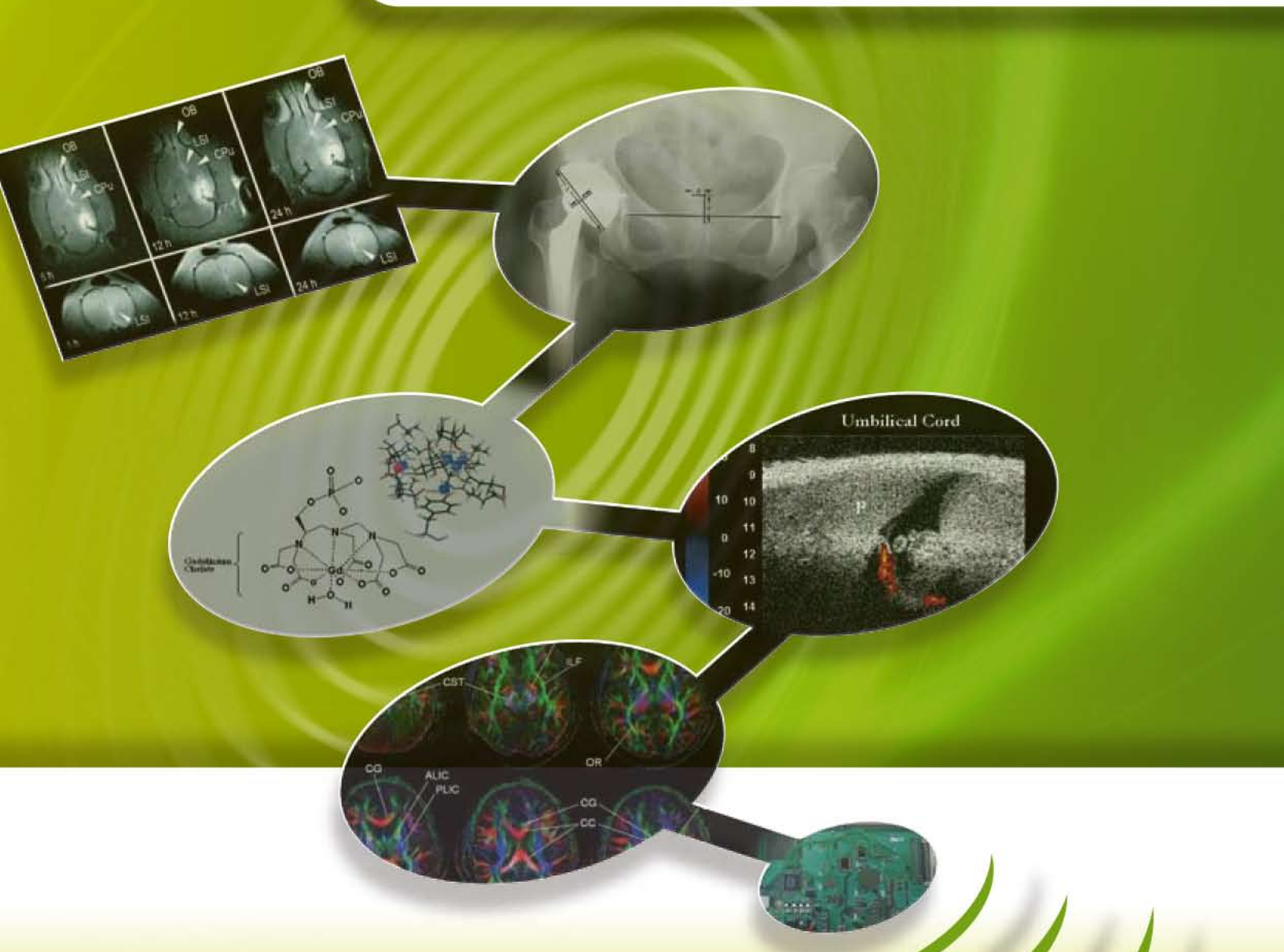

BEBI Annual Report, No.2/Sep.2008

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，除了有本院林致廷老師與陳中平老師加入本所陣容之外，我們也特別聘請林則彬博士擔任兼任教授，負責針對非生醫背景的學生開設生理學，以期達到更好的教學效果。另外，在新的學年，郭柏齡教授亦將加入電機系及本所的陣容。郭教授畢業自臺大醫學系、臺大電機所，隨後在哈佛大學取得工程及應用科學博士學位，是位難得且優秀的跨領域人才。他的加入，將進一步加強本所現有的跨領域師資陣容，對於各項教研工作之推動必有助益。

上一年度中，本所也推動臺灣-史丹佛醫療器材人才培訓計畫。此計畫由臺大搭配史丹佛大學頗負盛名的Biodesign program，致力於創新醫療器材之人才培訓，向下紮根，為國內醫療器材產業的創新注入活水。此外，我們也舉辦了第二屆臺大生醫電資營。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，顯見經過了連續兩屆的活動舉辦，本所推動的跨領域學習已開始獲得共鳴與成效。

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。

在四月份我們舉行了創所以來第一次的所務發展諮詢委員會議，在會議中由院士、長官與各界代表所組成的委員們，針對所務發展提出多項建議，也對過去的推動成果有些許肯定。未來所務的推動將以此會議結論做為主要依據，持續向前邁進。在上一年度中，我們也順利的簽訂臺大電資學院及醫學院，與美國芝加哥大學醫學院的國際合作協議，未來雙方將持續發展教育與研究之學術交流及合作。

去年是本所成立的第二年。感謝大家的支持與努力，所辦在行政人力與空間兩方面皆得以成長，提供教師與同學們更好的服務品質。明年本所第一屆碩士生將會畢業，希望大家繼續努力，將這一群優秀學生陶冶成為世界一流的跨領域人才。

李百祺

2008年8月

In the past year, promoting multidisciplinary research and teaching in the areas of Biomedical Electronics and Bioinformatics continued to be our main mission. Four new faculty members joined our institute in the last year, including Professor Chih-Ting Lin and Professor Chung-Ping Chen from our college, and Adjunct Professor Tzer-Bin Lin who will be offering the course "Physiology" to students without biomedical backgrounds. In addition, Professor Po-Ling Kuo recently joined us with a joint appointment with Department of Electrical Engineering. Professor Kuo is also a M.D., with M.S. from Electrical Engineering of NTU and Ph.D. from Engineering and Applied Sciences of Harvard University. With the addition of these new faculty members, I am sure that the multidisciplinary research and teaching efforts can be better integrated and consolidated.

We also started to participate with the Stanford-Taiwan Biodesign Program. This five-year program focuses on cultivation of medical device innovation, and it is hoped that it will plant the seeds for a more prosperous development of medical device industry in Taiwan. In addition to the Stanford-Taiwan Biodesign Program, we also held the second 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.

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.

The institute's first Advisory Committee was held in April, 2008. We had the honor of having two Academicians from Academia Sinica, NTU President, two Deans, and several other luminaries from various fields on our committee. Many valuable and constructive comments were generously given in the meeting, and these will certainly guide us as we move forward. In the last year, we also signed an agreement on academic cooperative activities between the Pritzker School of Medicine of University of Chicago, and the College of Electrical Engineering and Computer Science, and the College of Medicine of National Taiwan University. With this agreement, we will continue to develop academic exchange and cooperation in education and research between the two prestigious universities.

As always, we are thankful for all the supports that we received. It was the second year after our institute was founded, and we had opportunities to recruit new staff members and expanded our office space. With these, we hope that we provide a better service to the faculty and the students. In the next summer, we will have students graduating from our institute for the first time. I hope we can work together to make them true leaders in whatever field that they choose.

Pai-Chi Li

Professor and Director, Biomedical Electronics and Bioinformatics
August, 2008

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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，本所的獨特性在於電機與資訊兩大領域的結合，進行生物醫學之前膽研究及跨領域教學。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17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44名碩士新生加入(含2名在職專班)。本所有27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 NationalTaiwan University was formally founded on August 1, 2006. In a way, it is a very uniqueinstitute among those in College of Electrical Engineering and Computer Science, NationalTaiwan University, in that the fields of expertise are diversified but our efforts remainextremely focused. The main mission of the institute is to promote multidisciplinaryresearch and education in respond to the rapid advancement of biotechnology. In thisregard, the following areas have been identified as our focus areas which we have beenputting our major efforts in: biomedical electronics, molecular/cellular/tissue imaging, biomedical signal processing, biophotonics, sensors, microarrays, computer aideddiagnosis, bioinformatics, systems biology and medical informatics. To excel in theseareas and to bring up research synergy, integrative efforts from different disciplines arenecessary.

The BEBI institute started the doctoral program in August, 2006 and now we admit 17 new Ph.D. students every year. Our master program started in August, 2007 with 44 new students entering the institute annually. There are 27 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 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

林致廷　助理教授 Chih-Ting Lin, Assistant Professor

林致廷於1996年畢業於臺灣大學土木系後，1998年取得臺灣大學應用力學研究所碩士，服完兵役後前往美國密西根大學電機資訊研究所深造，並分別於2003及2006年取得電機碩士及博士學位。

於2006年進入臺灣大學成為電子工程學研究所、生醫電子與資訊學研究所及電機工程學系助理教授。主要之研究興趣為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。

Chih-Ting Lin received the B.S. degree in civil engineering and M.S. degree in applied mechanics from the National Taiwan University, in 1996 and 1998, respectively. He also received the M.S. and Ph.D. degree in electrical engineering and computer science from the University of Michigan, Ann Arbor, in 2003 and 2006, respectively.

Since September 2006, he has been with the National Taiwan University, where he is an assistant professor of the Graduate Institute of Electronics Engineering, the Graduate Institute of Biomedical Electronics and Bioinformatics, and the Department of Electrical Engineering. His current research interests include bio-MEMS, bio-chips, nano fabrication, and biomolecular detection technology.

陳中平　副教授 Chung-Ping Chen, Associate Professor

陳中平教授於1990年畢業於交大資訊工程學系，服完兩年的兵役後，隨即在1993年赴美國德州大學奧斯丁(University of Texas at Austin)分校攻讀電腦科學碩士及博士學位，並在1998年獲得電機資訊博士。老師主要的研究領域是VLSI Design及Design Automation。畢業前即於1996年即任職於Intel Research Lab研發中心參與高速微處理機(Pentium IV)的設計及電腦輔助軟體開發，他在1999年進入美國威斯康辛大學電子系擔任助理教授一職。2001年更獲得了美國國科會頒發的年輕學者研究獎，2002年又獲得了美國ACM Society頒發的傑出年輕學者研究獎，2002年4月又榮獲International Symposium on Physical Design頒發的Best Paper Award。有感於台灣在下一波IC and電腦輔助設計發展上的重要性，於2002年2月到臺灣大學電子所任職副教授。

陳中平老師認為，IC學術界必須預想產業界實際的未來的問題並帶動與產業界攜手並進，突破台灣產業界技術上的瓶頸，才能與國際競爭。陳老師並主張同時創造人才及就業機會，提升台灣IC設計的國際競爭力。老師雖於今年2月才剛回國，卻已多次拜訪園區的廠商，積極建立和廠商間交流的機制，目前更已擔任多家公司顧問，如Intel、Cadence、智原等，許多的建教合作案如與台積電已開始進行。不但如此，陳老師最近不僅開始與臺大本身的教授合作，更積極參與推動跨校的學術合作。

Charlie Chung-Ping Chen received his B.S degree in computer science and information engineering from the National Chiao-Tung University, Hsinchu, Taiwan, in 1990 and his M.S. and Ph.D. degrees in computer science from the University of Texas at Austin in 1996 and 1998. From 1996-1999 he was with Intel Corporation as a senior CAD engineer with Strategic CAD Labs. Since 1999, he has been an assistant professor in the ECE Department at the University of Wisconsin, Madison. Since 2003, he has been an associate professor in the EE department of National Taiwan University, Taiwan. His research interests are in the areas of computer-aided design and microprocessor circuit design with an emphasis on interconnect and circuit optimization, circuit simulation, and signal/power/thermal integrity analysis and optimization.

Prof. Chen served the program committee for most of the major VLSI Design Automation Conferences which include DAC, ICCAD, DAC, DATE, ISPD, ISQED, ASPDAC, and SASIMI. Prof. Chen received the D2000 award from Intel Corp. and National Sciences Foundation Faculty Early Career Development Award (CAREER) at 1999 and 2001, respectively. He also received the 2002 Sigda/ACM Outstanding Young Faculty award and 2002 Peter Schneider Faculty Development award. He received the best paper award from the International Symposium Physical Design, 2003.

郭柏齡　助理教授 Po-Ling Kuo, Assistant Professor

郭柏齡於西元1994年畢業於臺灣大學醫學系，1998年取得臺灣大學電機學院之碩士學位。他曾在臺灣大學附設醫院接受臨床訓練，並擔任三年復健部主治醫師，隨後赴美深造，並於2008年取得哈佛大學工程科學之博士學位。他的專長包括微奈米表面工程、分析生物系統在微米尺度下的自我重組及力學行為、以及復健醫學。他目前的研究方向在於探討細胞顯微環境對於組織發生、病變、老化及修復的影響。他特別針對細胞與細胞間質、以及細胞與細胞間的力學行為分析，並研究它們對細胞骨骼、細胞及組織型態學以及分化的影響。

Po-Ling Kuo has received his M.D. and M.S. with concentration in electrical engineering from National Taiwan University at 1994 and 1998, respectively. He has finished his residency at the National Taiwan University Hospital, and practiced as an attending physician specialized in rehabilitation for three years. He thereafter went to the U.S. and got his Ph.D. in engineering sciences at Harvard University at 2008. His expertise includes micro-nano surface engineering, analysis of mechanics and self-organization in biological systems at micro scales, and rehabilitation medicine. His current field of research focuses on the influence of microenvironment on tissue development, pathogenesis, aging, and repairing. He is interested in the mechanics between cell, extracellular matrix, and adjacent cells, in particular its role in the morphogenesis and differentiation of cell and tissues.

林則彬　兼任教授 Tzer-Bin Lin, Adjunct Professor

林則彬教授出生於美麗的宜蘭縣，在基隆市渡過多雨的童年。高中時就讀於台北市立中正高級中學。1986年進入國立臺灣大學醫學院復建醫學系，畢業後進入國立臺灣大學生理學研究所博士班，並於1998年完成博士學位。在完成學位之後便服務於中山醫學大學醫學系、歷任中山醫學大學醫學系生理學科助理教授、副教授、教授 (2004)及生理學科主任。目前擔任中山醫學大學醫學系生理學科教授、台灣高等教育評鑑委員會生理學門規劃委員、聖保祿醫院醫療部顧問以及台北市立中山女中吉他社指導老師。學術專長是系統神經生理學及感覺神經生理學。目前從事於泌尿生殖系統神經可朔性相關的研究主題，希望可以和相關主題的同仁相互討論、合作。

Professor Tzer-Bin Lin was born in I-Lan County. He graduated from the Department of Rehabilitation Medicine in National Taiwan University and then finished his PhD program in the Graduated Institute of Physiology, National Taiwan Universtiy in 1988. Now, he is a professor in the Department of Physiology, School of Medicine, Chung-Shan Medical University in Taichung city. The Topic he investigating is the activity-dependent reflex plasticity at the lumbosacral spinal cord level innervating urogenital organs.

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在於DNA微陣列晶片之製程、感測技術與資料分析方法，並應用DNA微陣列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，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, development of new data analysis methods for DNA microarrays, and development of miniature biosensors based on surface plasmon resonance (SPR). 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｜重點計畫介紹

Core Projects

一、 臺灣-史丹佛醫療器材產品設計人才培訓課程

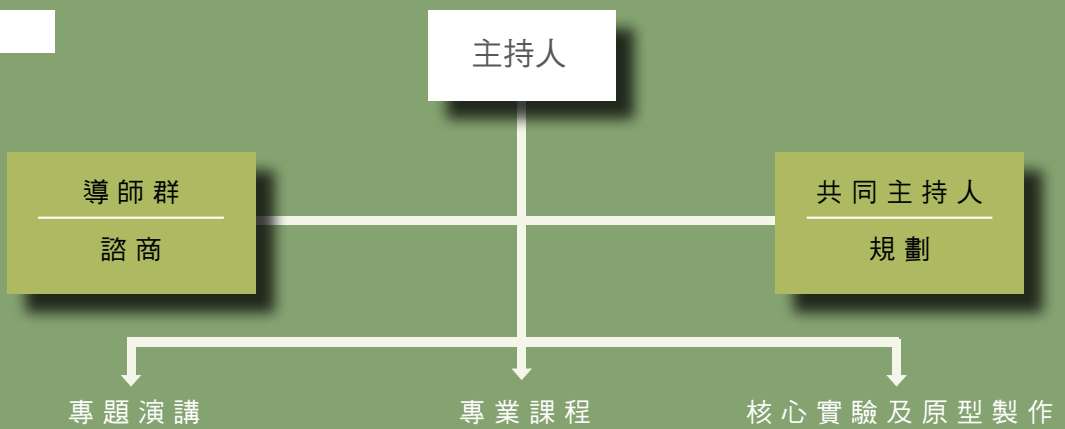
計畫簡介

為培育臺灣高階醫療器材的跨領域人才，臺大生醫電子與資訊學研究所，承辦國家實驗研究院之「臺灣—史丹福醫療器材產品設計之人才培訓計畫」。本培訓計畫強調跨領域合作、臨床需求導向、創新產品研發與新事業開創等核心精神，以期能協助建立臺灣醫療器材產業之優勢，促進產學合作成效。


台灣—史丹福醫療器材產品設計之人才培訓計畫
Stanford-Taiwan Biomedical Fellowship Program

在課程的規劃主要包括兩大部分，即「專業課程」與「核心實驗與原型設計」。在「專業課程」中參考Stanford University之Biodesign課程設計，涵蓋臨床需求、創新創業、法規認證、專利與智財管理、工程技術與創新研發等內容，邀請相關領域傑出人士，每期分10次上課，每年共二期。除上述課程外，本計畫特別建立一導師制度(mentor program)，結合臨床、法規、創業育成語產業界資源，給予學員在培訓各階段之諮詢與支援。

計畫架構



Stanford-Taiwan Biodesign Fellowship Program

Project Description

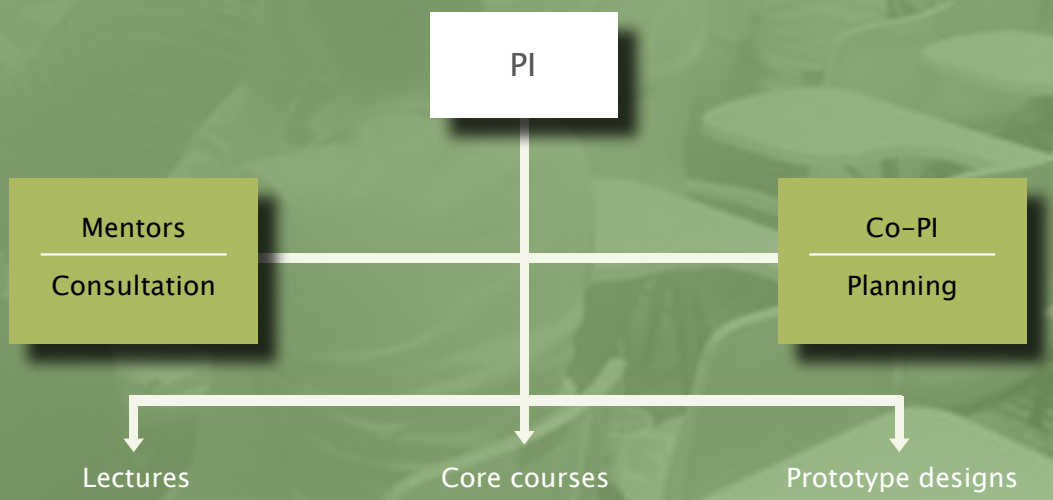
To educate multidisciplinary talents for the advanced medical device industry in Taiwan, our institute has been executing the parallel program of the Stanford-Taiwan Biomedical Fellowship Program. This program emphasizes on cross-disciplinary collaboration, clinical needs finding, innovative product developments, and entrepreneurship, hoping that it can assist in building the competitive edge of Taiwan's medical device industry, and promote the synergy of collaboration between academia and industry.

The program consists of two major parts:

1. Core courses: Similar to the Biodesign program of Stanford University, the core courses include aspects of clinical needs finding, innovation, entrepreneurship, regulatory affairs, patents and intelligent properties, engineering technologies, and creative developments. We invited outstanding experts from these various fields to make sure the success of this program.
2. Prototyping facilities: This program also integrates various resources on campus, including those from Nano-Electro-Mechanical-Systems Research Center, Machine Shops, and Biomedical Engineering Lab.

Moreover, the program also implements a mentor program so that students can seek advice from mentors during the training process.

Project Structure



二、 跨學門科學人才培育銜接計畫

參與單位

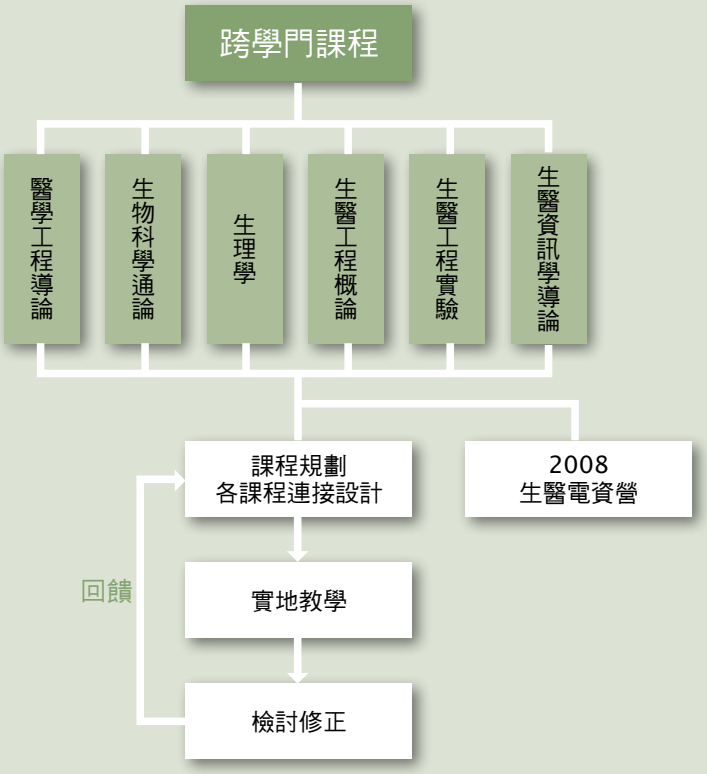
國立臺灣大學電機資訊學院
國立臺灣大學生命科學院

計劃簡介

本計畫之目標為臺大生命科學院與電資學院之共同合作，透過二院教師之整合參與，將為工程背景同學，特別是電資學院之大學部同學，提供一系列跨領域課程，以為日後進入生醫工程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生醫電資相關之前瞻研究。本計畫包括以下六門課（含一門實驗課）：生物科學通論、生理學、生醫工程概論、醫學工程導論、生醫資訊學導論、生醫工程實驗。此外，臺大生醫電資所亦將舉行生醫電資營之營隊活動，做為學生們於暑假期間之搭配活動，與本子計畫相輔相成。

本計畫透過臺大生命科學院與電資學院之結合與豐富多元、深入淺出的課程規畫，可向大學部的學生介紹此領域之跨領域銜接知識，為有意朝此領域投入更深入研究之學生，適切的做了一座接軌的橋樑。課程設計之預期成效包括課程內容之重新檢討、教材規劃準備、與各課程間之連接設計，亦將建立課程效果評量與回饋機制，參考學生們於第一年修課後之成效與意見，進行改善，並完成所有之課程規劃。

計劃架構



The Interdisciplinary Training Program for Talented College Students in Science

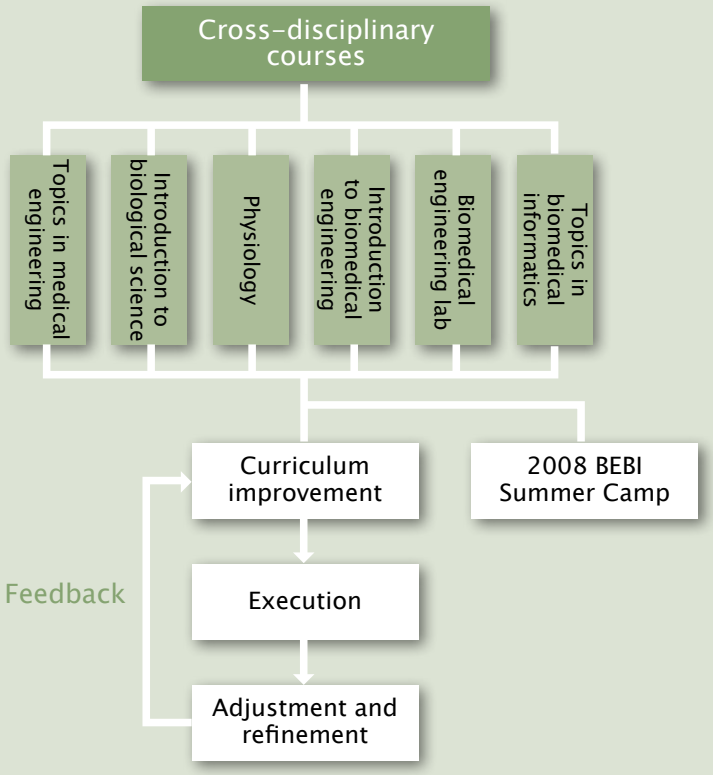
Participants:

College of Electrical Engineering and Computer Science, NTU
College of Life Science, NTU

Project Description

This project is a joint effort between College of Life Science and College of Electrical Engineering and Computer Science of National Taiwan University. Through integration, consolidation and participation from both colleges, we refine a series of cross-disciplinary courses to engineering students (particularly those with electrical engineering and computer science backgrounds), so that they can be ready to enter the biomedical engineering field after taking these courses. Six courses are included in this project (including one lab course). In addition, the Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University organizes a summer camp for the students, as a supplement to this project in order to provide another opportunity for the students to learn under a diverse environment. The six courses are: Introduction to biological science, Physiology, Introduction to biomedical engineering, Topics in medical engineering, Topics in biomedical informatics, Biomedical engineering lab.

Project Structure



Through this project, collaboration between College of Life Science and College of Electrical Engineering and Computer Science enables us to offer to the students a wide range of courses with fundamental knowledge in several different disciplines. These courses will be a bridge to connect two different fields. An evaluation and feedback mechanism will also be implemented, so that the courses can be continuously improved and the needs of the students can be met.

伍｜學術活動

Academic Activities

Date	Academic Activities
2007/08/28~09/01	參訪、演講/ Visit and Lecture- Dr. Patrick La Riviere, Chicago University, USA
2007/09/17	演講/ Lecture-Dr. Arthur Er-Terg Chiou 邱爾德 院長
2007/09/21	參訪/Visit Dr. Juan F. Arratia, Universidad Metropolitana, Puerto Rico
2007/10/01	參訪/Visit Dr. Christian Roux/ Dr Raymond Pommet/ Dr Serge Haan, National Research Agency, French
2007/10/08	演講/ Lecture-Dr. Hui-Po Wang 王惠珀 院長
2007/10/15	演講/ Lecture-Dr. Charles T.M. Choi 蔡德明 教授
2007/10/19	參訪/Visit Dr. Hiroshi Fujita, Gifu University, Japan
2007/10/16、19	碩士班甄試說明會 BEBI Introduction to Prospective Students(Ⅰ、Ⅱ)
2007/10/22	演講/ Lecture-Dr. Kang-Ping Lin 林康平 理事長/教授
2007/10/29	演講/ Lecture-Dr. Bon-Chu Chung 鍾邦柱 博士
2007/11/05	演講/ Lecture-Dr. Henry Horng-Shing Lu 盧鴻興 教授
2007/11/07	參訪/ Visit 資策會 Institute for Information Industry
2007/11/14	電機資訊學院暨生命科學院之跨院 mini-symposium Mini-symposium between College of Electrical Engineering and Computer Science and College of Life Science
2007/11/19	演講/ Lecture-Dr. Yeukuang Hwu 胡宇光 博士
2007/11/26	演講/ Lecture-Dr. Michelle M.S. Lin 林美雪 博士
2007/12/03	演講/ Lecture-Dr. Konan Peck 白果能 博士
2007/12/10	演講/ Lecture-Dr. Vincent S. Tseng 曾新穆 教授
2007/12/24	演講/ Lecture-Dr. Fu-Jen Kao 高甫仁 所長
2007/12/28	IEEE fellow慶祝茶會 IEEE fellow ceremony

Date	Academic Activities
2008/01/03	期末聚會活動 Year-end gathering
2008/01/04	演講/ Lecture-Dr. Chunlei Liu 劉春雷 博士
2008/02/01	參訪/Visit Dr. Ching-Husan Tung, Harvard Medical School
2008/02/25	演講/ Lecture-Dr. Jenn-Kang Hwang 黃鎮剛博士
2008/03/03	演講/ Lecture-Dr. Henry Horng-Shing Lu 盧鴻興教授
2008/03/10	演講/ Lecture-Dr. Tzu-Chen Yen 閻紫宸主任
2008/03/12	參訪/Visit Dr. Peter Fitzgerald, Stanford University, USA
2008/03/17	演講/ Lecture-Dr. Ovid J.L. Tzeng 曾志朗教授
2008/03/24	演講/ Lecture-Dr. Cheng-Yi Wang 王正一教授
2008/03/31	演講/ Lecture-Dr. Chen-Chi M. MA 馬振基教授
2008/04/07	演講/ Lecture-Dr. Curtis Chang 張立明醫師
2008/04/10	所務發展暨IEET諮詢會議 The advisory commitee of BEBI and IEET
2008/04/14	演講/ Lecture-Dr. Hon-Man Liu 廖漢文醫師
2008/04/21	演講/ Lecture-Dr. Shan-Ju Lin 林珊如教授
2008/04/28	演講/ Lecture-Dr. Nan-Chi Chang 張南驥教授
2008/05/05	演講/ Lecture-Dr. C.K. Lee 李世光副院長
2008/05/12	演講/ Lecture-Dr. Norden E. Huang 黃 鍔院士
2008/05/19	演講/ Lecture-Dr. Yi-Ning Su 蘇怡寧醫師
2008/06/09	演講/ Lecture-Dr. Hsiu-Po Wang 王秀伯醫師
2008/06/13	演講/ Lecture-Dr. Pan-Chyr Yang 楊泮池院長
2008/07/02~04	生醫電子資訊營 Biomedical Electronics and Bioinformatics Camp

活動報導 Activities

去年的活動，除了將5場國際學術交流及1場學生暑期研習營外，特將專題演講之豐碩成果與您分享，本所於今年將專題演講納入本所碩博士生之必修課程之一，並廣邀不同專題領域之學者專家蒞臨，透過29場演講帶給學生們更多元、豐富的視野。

There were numerous academic activities held within last year. In addition to five international conferences and a summer camp, we also had department seminar to promote student interests in this multidisciplinary field. In detail, department seminar was designed as one of the required courses. In the seminar series, the speakers with different expertise were invited. Based on this arrangement, we provided students with integrated knowledge base and different point of view.

一、 2007/10/16， 碩士班甄試說明會(第一場：生命科學院)
BEBI introduction to prospective students: Part I, College of Life Science

2007/10/19， 碩士班甄試說明會(第二場：電資學院)
BEBI introduction to prospective students: Part II, College of Electrical Engineering and Computer Science

二、 2007/11/07，資策會參訪
Institute for Information Industry

三、 2008/11/14，電資學院暨生科院之跨院 mini-symposium
Mini-symposium between College of Electrical Engineering and Computer Science and College of Life Science

四、 2007/12/28，IEEE fellow慶祝茶會
IEEE fellow ceremony

五、 2008/01/03，期末聚會活動
Year-end gathering

六、 2008/04/10，所務發展暨IEET諮詢會議
The advisory commitee of BEBI and IEET

七、演講 Lectures

1. 2007/08/31，
   Dr. Patrick J. La Rivière, The University of Chicago
   Topic: Development of protease-sensitive molecular probes and acoustic attenuation correction schemes for optoacoustic tomography

2. 2007/09/17，
   Dr. Arthur Er-Terg Chiou, National Yang-Ming University
   Topic: From Optical Tweezers & Stretcher to Photonics Force Microscopy and Optical Forced Oscillation: Principles and Potential Biomedical Applications

3. 2007/10/08，
   Dr. Hui-Po Wang, Taipei Medical University
   Topic: Utilization of National Health Insurance Database to Analyze Medication Risk in Taiwan: Aspects of IPR and Drug Pricing Policy

4. 2007/10/15，
   Dr. Charles T.M. Choi, National Chiao Tung University
   Topic: Cochlear Prosthesis

七、演講 Lectures

5. 2007/10/22，
Dr. Kang-Ping Lin, Biomedical Engineering Society, ROC
Topic: 全聚焦之顯微鏡影像合成

6. 2007/10/29，
Dr. Bon-Chu Chung, Academia Sinica
Topic: 荷爾蒙與健康

7. 2007/11/05，
Dr. Henry Horng-Shing Lu, National Chiao Tung University
Topic: Is Less More? On Statistical Investigation for Large Biological Networks

8. 2007/11/19，
Dr. Yeukuang Hwu, Academia Sinica
Topic: Nanoimaging, Nanofabrication and Nanomedicine with Synchrotron X-rays

9. 2007/11/26，
Dr. Michelle M.S. Lin, National Applied Research Laboratories
Topic: The Development of Biotechnology: Industrial Revolution and Prospects

10. 2007/12/03，
Dr. Konan Peck, Academia Sinica
Topic: An Interdisciplinary Technology Pipeline for Gene Expression Analysis and Biomarker Identification

11. 2007/12/10，
Dr. Vincent S. Tseng, National Cheng Kung University
Topic: Biomedical Data Mining: Trends and Recent Development

12. 2007/12/24，
Dr. Fu-Jen Kao, National Yang-Ming University
Topic: Implementing Time-Resolved Microscopy for Molecular Dynamics Imaging

七、演講 Lectures

13. 2008/01/04，
Dr. Chunlei Liu, Stanford University
Topic: In Vivo MRI of Neural Connectivity

14. 2008/02/25，
Dr. Jenn-Kang Hwang, National Chiao Tung University
Topic: On the relationship between protein structure and dynamics

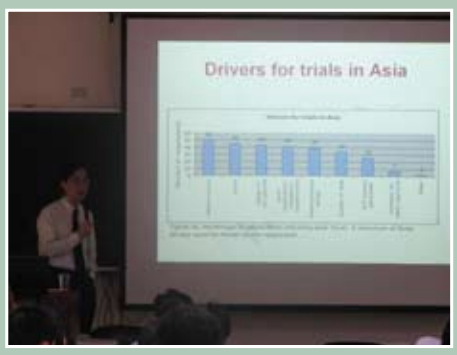
15. 2008/03/03,
Dr. Henry Horng-Shing Lu, National Chiao Tung University
Topic: Reconstruction, Visualization and Analysis of Medical Images

16. 2008/03/10,
Dr. Tzu-Chen Yen, Chang Gung Memorial Hospital
Topic: Bioimaging as Biomarker in Translational Researches

17. 2008/03/17,
Dr. Ovid J.L. Tzeng, Academia Sinica
Topic: Visualizing How the Brian Reads: How High-Tech Reveals the Neuroimages of An Educated Reader

18. 2008/03/24,
Dr. Cheng-Yi Wang, National Taiwan University Hospital
Topic: 新時代的臨床醫學倫理概念、理論與實務

19. 2008/03/31,
Dr. Chen-Chi M. MA, National Tsing Hua University
Topic: 研發過程中如何保護智財權



20. 2008/04/07,
Dr. Curtis Chang, Eli Lilly and Company
Topic: 生技產業的基因相關倫理

七、演講 Lectures

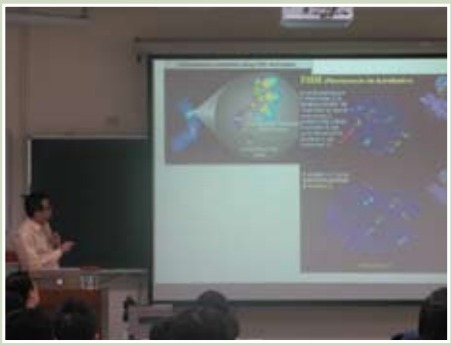
21. 2008/04/14,
Dr. Hon-Man Liu, National Taiwan University Hospital
Topic: In vivo imaging of cancer at molecular level

22. 2008/04/21,
Dr. Shan-Ju Lin, National Taiwan University
Topic: 學術欺騙與寫作倫理

23. 2008/04/28,
Dr. Nan-Chi Chang, National Yang-Ming University
Topic: 幹細胞的奧秘

24. 2008/05/05,
Dr. C.K. Lee, Industrial Technology Research Insitute
Topic: Academic Research, Ethics and Responsibilities
of an Academic Scholar: Course 101

25. 2008/05/12,
Dr. Norden E. Huang, National Central University
Topic: A Plea for Adaptive Data Analysis: An introduction of HHT



26. 2008/05/19,
Dr. Yi-Ning Su, National Taiwan University Hospital
Topic: Current Aspects of Clinical Molecular Genetics

27. 2008/06/09,
Dr. Hsiu-Po Wang, National Taiwan University Hospital
Topic: 21世紀內視鏡光學影像診斷下的世界

28. 2008/06/13,
Dr. Pan-Chyr Yang, National Taiwan University College of Medicine
Topic: Translational Research and Personalized Therapy of Lung Cancer

八、 2008/07/02~04 生醫電子資訊營

生醫電子資訊營為響應2007年參與學員之鼓勵與建議，2008年持續辦理，於7月2~4日假臺灣大學博理館舉行，活動透過規畫設計的課程及課後的競賽活動，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。透過主題課程的設計及實驗室參觀，使學員對此跨領域學門有一深入的認識，並培養其興趣，作為進入相關領域之準備，並為國家培養生物科技與醫療電子資訊的學術與產業人才。

課程內容包含神經電子、生醫影像、基因晶片、微感測器、醫療輔具、醫學資訊、生物資訊、系統生物學、生物資訊軟體操作及實驗室參觀。

由報名資訊分佈顯示，報名相當踴躍，有113人報名參加，跨領域：生醫領域：電資領域的學員比例為1：6：5。統計學員參與活動後所填之問卷，對於活動規劃的滿意度，有97%的學員表示滿意本活動規劃，並給予本所支持與鼓勵，後續若有相關活動，還會持續參加。

2008/07/02~04 Biomedical Electronics and Bioinformatics Camp

2008 Biomedical Electronics and Bioinformatics Summer Camp, known as BEBI summer camp, was held on July 2-4 at Barry building in NTU. The main theme of this event was introducing the advanced technologies to promote the fundamental life science researches and applied medical treatments. Based on the course designs and lab tours in the camp, the interdisciplinary knowledge were covered and introduced to the participants. Utilizing these introductory curriculums, the interests for developing biotechnology and bioinformatics can be stimulated and identified.

In detail, our curriculum had four topics: Biomedical Image, Biochips, Bioinformatics, and Medical Informatics. These topics can be introduced with the following courses: neuron-potential, biomedical image, gene-chip, biomedical micro sensor, medical orthotics, medical informatics, bioinformatics, systematic biology, and laboratory visit.

We had a total of 113 participants with diverse backgrounds (engineering and life science). A 97% satisfaction rate was achieved.

陸｜國際交流

International Exchange

一、 外賓參訪 International Visits

1. 2007/08/28~09/01 ｜ Dr. Patrick J. La Rivière, The University of Chicago

2. 2007/09/21 ｜ Dr. Juan F. Arratia, Universidad Metropolitana, Puerto Rico

3. 2007/10/01 ｜ Dr. Christian Roux/ Dr Raymond Pommet/ Dr Serge Haan, National Research Agency, French

4. 2007/10/19 | Dr. Hiroshi Fujita, Gifu University, Japan

5. 2008/02/01 | Dr. Ching-Husan Tung, Harvard Medical School

6. 2008/03/12 | Dr. Peter Fitzgerald, Stanford University, USA

7. 2008/04/23 | Dr. Randal E. Bryant, Carnegie Mellon University, USA

柒｜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
超音波影像實驗室 Ultrasonic Imaging Lab.	李百祺 Pai-Chi Li	明達館731 MingDa Building, Room 731
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
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
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
醫學影像實驗室/磁共振影像頻譜實驗室 Medical Imaging Lab.	陳志宏 Jyh-Horng Chen4	明達館706 MingDa Building, Room 706
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
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
醫用微感測器暨系統實驗室 Medical Micro Sensor and System Lab.	林啟萬 Chii-Wann Lin	展書樓605/608 Jan Su Hall, Room 605/608
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
非侵入式生理量測實驗室 Non-invasive physiological measurements Lab.	王唯工 Wei-Kung Wang	明達館 705 MingDa Building, Room 705
整合神經生理學實驗室 Integrative Neurophysiology Lab.	林則彬 Tzer-Bin Lin	中山醫學大學基礎醫學大樓 Chung Shan Medical Univ.
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
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
生物資訊暨生物統計核心實驗室 Bioinformatics and Biostatistics Lab.	莊曜宇 Eric Y. Chuang	明達館 701 MingDa Building, Room 701

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
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
無線生醫晶片系統實驗室 Wireless Bio-Electronics-System Lab.	林致廷 Chih-Ting Lin	電機二館450 EE 2, Room 450

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
低功率超大型積體電路實驗室 Low Power VSLI Lab.	賴飛羆 Fei-pei Lai	資訊館419 CSIE Building, Room 419
分子生醫資訊實驗室 Knowledge Engineering and Bioinformatics Lab.	歐陽彥正 Yen-Jen Oyang	資訊館431 CSIE Building, Room 431
生物資訊實驗室 Bioinformatics Lab.	高成炎 Cheng-Yan Kao	資訊館418 CSIE Building, Room 418
數位典藏與自動推論實驗室 Automated Reasoning Lab.	項潔 Jieh Hsiang	資訊館323 CSIE Building, Room 323
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327 CSIE Building, Room 327
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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
生物資訊與化學資訊實驗室 Bioinformatics and Cheminformatics Lab.	曾宇鳳 Y. Jane Tseng	資訊館529 CSIE Building, Room 529

李百祺 教授兼所長 *Li, Pai-Chi*, Professor and Director

國立臺灣大學生醫電子與資訊學研究所 所長兼教授
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超音波影像實驗室

Ultrasonic Imaging Lab.

主要研究領域

生物醫學工程、超音波影像、生醫光聲影像

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。

Major Research Areas

Biomedical Engineering, Ultrasound Imaging, Biomedical Photoacoustics

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.

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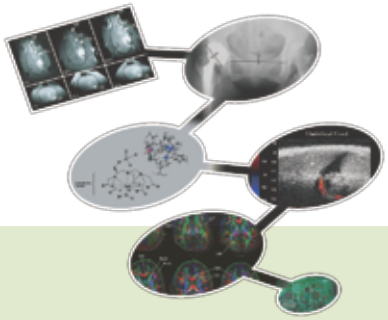

研究計畫

1. 使用奈米金粒子之多目標光熱治療與光聲影像技術
2. 前瞻無線微型醫學影像系統：關鍵元件系統與臨床診斷技術開發
3. 超音波釋控微脂體科技於腫瘤預防診斷治療之研究
4. 乳癌治療抗療性之整合研究
5. 國立臺灣大學促進產學合作先導型研究計畫-【生物科技研究之超音波顯微鏡影像系統】
6. 國立臺灣大學邁向頂尖大學前瞻性研究計畫-【生醫標的追蹤之整合性前瞻科技:以口腔癌為主要應用】

Research Projects

1. Gold nanoparticles for multiple selective photothermal therapy and photoacoustic imaging
2. Advanced wireless medical imaging microsystem: core technology development of devices, systems and clinical diagnosis
3. Ultrasound assisted liposomal cancer therapy
4. Integrated approach to dissecting resistance of anti-cancer treatment
5. Ultrasonic micro-imaging systems for biotechnology research
6. Integrated technologies for biomedical target tracking: oral cancer as the primary application

計畫名稱：使用奈米金粒子之多目標光熱治療與光聲影像技術
補助單位：國家衛生研究院
計畫期間：2007/01/01-2009/12/31

摘要：本整合性計畫之長程目標是利用金奈米粒子建立先進之光聲診斷及光熱治療技術。為達此長程目標，本三年期計畫將進行以下主要工作：適於定量分析、微循環量測及同時多重靶向偵測之顯微影像技術；使用奈米金粒子之靶向光熱治療法；及金奈米粒子之生物相容性評估。本整合性計畫之主要動機是基於金奈米桿之獨特性質，這些性質包括與形狀相關之光聲特性及因雷射照射所產生之形狀變化。基於這些性質，上述之光聲影像技術才得以開發。本計畫配合離體驗證、動物影像與生物相容性評估，計畫之長期目標才有可能達成。本計畫包括三項子計畫，涵蓋各研究課題從物理、成像、奈米材料、化學、至生物醫學之各個面向。本計畫亦包括一核心設施，以提供各分項所需之功能性奈米金粒子為主要服務項目。為達上述目標，本計畫之主要研究工作包括：

- 反向模式中光吸收係數影像重建技術開發
- 高顯像速度、高解析度之光聲顯微影像系統建立
- 同時多重靶向偵測與癌症離體影像之評估（分子影像技術）
- 光聲血流及微循環計算技術（功能影像技術）
- 奈米粒子光、熱及聲學性質之模式建立、模擬與最佳化
- 使用奈米粒子之光熱治療技術建立
- 金奈米粒子之生物相容性測試評估

最後，本計畫將以口腔癌為目標應用，以有效進行研究整合與技術開發。本計畫之有效執行，將可進一步發揮奈米金粒子於生物醫學科學之應用潛力。

Project title: Gold Nanoparticles for Multiple Selective Photothermal Therapy and Photoacoustic Imaging
Supported by: National Health Research Institutes
Project period: 2007/01/01-2009/12/31

Abstract: The long-term goal of this project is to utilize unique characteristics of gold nanopaticles and to develop advanced photoacoustic imaging and photothermal therapy technologies. To meet this long-term goal, the research tasks in the proposed three-year project period will focus on (1). development of advanced photoacoustic micro-imaging technologies for quantitative analysis, measurements of hemodynamic functions, and simultaneous detection of multiple selective targeting; (2). evaluation of selective photothermal therapy technologies, and (3). biocompatibility tests of conjugated gold nanoparticles. The program project is primarily motivated by the unique properties of gold nanorods. These properties include the shape dependence of the photoacoustic response and the shape transformation under laser irradiation. With these properties, the above mentioned advanced biomedical technologies can be developed. With the in vitro verification, in vivo animal imaging and the biocompatibility evaluation of the nanoparticles, the long-term goal can thus be pursued. The program project consists of three component projects, covering all aspects of the research problem from physics and imaging, nano materials and chemistry, to biology and medicine. A core unit will also be established to provide bioconjugated gold nanoparticles to all component projects. To this end, specific aims of this project include:

- Development of backward mode imaging methods for reconstruction of optical absorption coefficient.
- Construction of a photoacoustic micro-imaging system with high frame rate and high spatial resolution.
- Evaluation of simultaneous detection of multiple selective targeting (for molecular imaging).
- Investigation of blood flow and perfusion measurement techniques (for functional imaging).
- Modeling, simulations and optimization of optical, thermal and acoustic properties of nanoparticles.
- Testing of the in vitro cytotoxicity, genotoxicity, hemocompatibility, acute and subacute systemic toxicity of the nanorods with different shapes and surface modifications.

Finally, this project will use oral cancer as a target model for integration of research efforts and a vehicle for technology development. With the success of this project, the full potential of gold nanoparticles in biomedical sciences can then be fully realized.

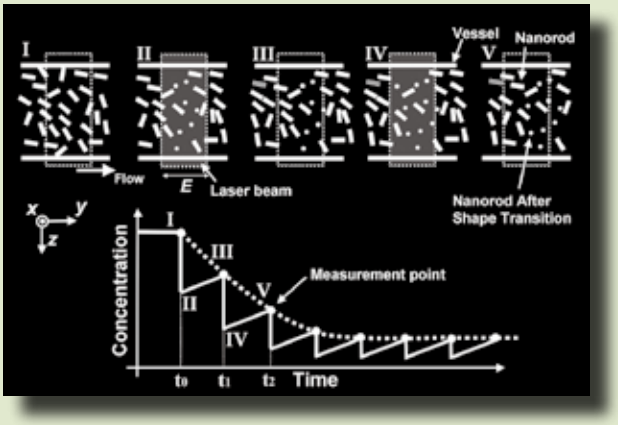

Illustration of a wash-in, time-intensity based flow estimation method utilizing the shape change of gold nanorods after laser irradiation.

本圖顯示利用金奈米桿受到雷射照射後之形變特性，所發展出之以流入-時間強度為基礎之流速測量方法。

李嗣涔 教授 *Lee, Si-Chen*, Professor

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薄膜電晶體實驗室
TFT Lab.

主要研究領域

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植物生長之應用

薄膜電晶體實驗室（TFT Laboratory）由李嗣涔教授領導，是臺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，我們也會研究窄頻紅外線光源照射對植物產生抗氧化性之行為表現。

Major Research Areas

Quantum Dot and Quantum Ring Photodetector, Amorphous and Poly-Si Thin Film Transistor, Plasmonic Thermal Emitter and Its Application on Plant Growth

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.

Our lab has developed the narrow bandwidth, tunable wavelength and room temperature operated infrared thermal emitter utilizing the surface plasmon. It has been applied successfully to the study of gene expression during the growth of plants. In the future, we plan to investigate the growth of Arabidopsis and the signal transmission of neuron when irradiated by this narrow bandwidth light source.

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研究計畫

1. 前瞻奈米紅外線光源及偵測器
2. 高性能主動矩陣有機電激發光顯示：關鍵材料、元件與技術研究--
   子計畫三：AMOLED關鍵TFT元件及介質薄膜技術研究
3. 結合奈米結構及光子晶體之紅外線光源與偵測器
4. 家用型雙波段乳癌紅外線診斷系統
5. 量子結構雙波段紅外線焦平面陣列元件製作

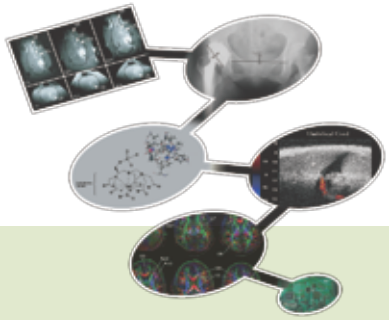
Research Projects

1. Advanced Nano Infrared Light Sources andDetectors
2. High performance active matrix organic electroluminescence display：key material, device and technology research-subproject 3：Key TFT device and dielectric thin film technology research of AMOLED
3. An Infrared light soure and detector combined with nano photonic crystal structure
4. A Novel Household Dual-Spectrum IR Imaging System for Breast Cancer Detection
5. Fabrication of Dual Band Quantum Structure Infrared photodetector Focal Plane Array

計畫名稱：前瞻奈米紅外線光源及偵測器
補助單位：行政院國家科學委員會
計畫期間：2007/08/01-2008/07/31

本實驗利用上下不同週期性金屬孔洞陣列製作出以金屬/二氧化矽/金屬三層結構為主的紅外線熱輻射器並研究探討其熱輻射頻譜。表一列出組成元件A、B、C的上下兩層金屬週期結構之參數。元件的側視圖如圖一(a)所示。圖一(b)表示元件A在不同溫度下熱輻射頻譜的差異差異，在上下兩層均為相同週期金屬孔洞，元件A在輻射頻譜的表現上與單層金屬週期結構時相同。表二顯示熱輻射元件在單層金屬週期結構時，表面電漿模態所表現出的頻譜位置對應不同金屬週期與結構時之關係。圖二(a)與(b)分別表示元件B與C在不同溫度下的熱輻射頻譜圖。在元件B中，上下層銀/二氧化矽的表面電漿模態應會同時產生，但是下層銀/二氧化矽的表面電漿模態會消失，因為上層金屬週期性孔洞扮演著濾波的角色，阻擋下層的電漿模態通過。在元件C中，除了會看到上層正方形排列的週期性金屬孔洞陣列所造成的銀/二氧化矽電漿模態外，還會看到下層三角晶格排列造成的銀/二氧化矽電漿模態，這是因為下層的表面電漿模態與上層的(1, 1) 銀/二氧化矽電漿模態產生藕合。元件的熱輻射主要由上層週期金屬的電漿模態來決定，下層電漿模態若與上層金屬的模態產生藕合即可穿過上層金屬，否則就會被過濾。藉由實驗之發現，我們可以設計多波段且窄頻的紅外線熱輻射發射器。

另一個重要的議題關於此結構中上層週期性銀孔洞陣列所扮演的角色是一個濾波還是具有光增益的作用？在此三層結構中，中間層二氧化矽的厚度均為100 nm，在過去的實驗中發現長波長的輻射頻譜似乎會被抑制進而轉換成較強的表面電漿輻射。本實驗的樣品側視與俯視圖如圖三(a)與(b)所示。圖四(a)(b)(c)(d)分別代表樣品(1)(2)(3)(4)在攝氏200度下之熱輻射頻譜，其中： (1)銀/二氧化矽/銀，厚度為 200nm/100nm/200nm，其中上層銀不具週期性孔洞，(2)二氧化矽/銀，厚度為 100nm/200nm，(3)熱輻射器A，且上層銀為三角形排列之週期孔洞陣列，(4)熱輻射器 B，且上層銀為方型排列之週期孔洞陣列。在圖四(c)與(d)中，同時顯現出理論上二氧化矽裸露所造成的熱輻射頻譜。藉著比較輻射頻譜強弱，發現在(1, 0)銀/二氧化矽的模態上，幾乎可達十倍的輻射增強。當上層銀為方型排列之週期孔洞陣列時，輻射強度也可增強好幾倍，發現上層銀的作用不僅是有濾波效果，更具有增益訊號的功用，同時也發現熱輻射增益的效果與週期結構的排列方式無關。



Project title: Advanced Nano Infrared Light Sources and Detectors
Supported by: National Science Council
Project period: 2007/08/01-2008/07/31

Metal/SiO_2/metal trilayer thermally generated infrared emitters with different top and bottom periodic metal arrangements were fabricated and their emission spectra were measured. The top and bottom periodic structure of the Ag/SiO_2/Ag sandwiched structures were listed in Table 1. The schematic diagrams showing the side view of the device structure were illustrated in Fig. 1 (a). The emission spectra were measured at different temperature shown in Fig. 1 (b) for devices A. Table 2 lists the peak positions of SP modes of a single periodic layer structure with different lattice parameters of square and triangular lattice. The emission spectra of device B and C at different temperature were shown in Fig. 2 (a) and (b), respectively. In device B, the top and bottom SPs were induced simultaneously, the top Ag/SiO_2 triangular mode is clearly seen, but the bottom Ag/SiO_2 mode disappears completely in the emission spectra because the top triangular lattice act as a metallic filter which filtered out the thermal radiation comes from the bottom Ag/SiO_2 surface. In device C, one of the bottom Ag/SiO_2 triangular lattice SP mode can also be seen in Fig. 2 (b). This is because the bottom Ag/SiO_2 triangular lattice SP mode is coupled to top (1,1) Ag/air square lattice SP mode which results in the emission spectra of triangular lattice. Top SP converted to light radiation directly. The radiation route of bottom SP must penetrate through the top periodic Ag film. The key idea is that the top periodic structure acts as a filter. Whether the emission of the bottom layer can come out depends on the matching of the emission peak positions to those of the top periodic metal structure. It opens the way to fabricate various optoelectronic devices and can be used as a high temperature operated, narrow bandwidth and multi-wavelength infrared light source.

The emission spectra of Ag/SiO_2/Ag tri-layer plasmonic thermal emitters were investigated. An important question needs to be solved in our Ag/SiO_2/Ag plasmonic thermal emitter is the role played by the top silver film perforated with periodic hole arrays, a filter or an amplifier? In our Ag/SiO_2/Ag tri-layer emitter, the 100 nm silicon dioxide sandwiched between two Ag metals, the thermal radiation of SiO_2 and Ag at longer wavelength seems to be suppressed and converted to the strong surface plasmon polaritons (SPPs). The schematic side and top views of the plasmonic thermal emitters were shown in Fig. 3(a) and (b), respectively. Figures 4(a), (b), (c), and (d) display the emission spectra of four emitters at 200℃, i.e., (1) Ag/SiO_2/Ag tri-layer structure (200nm/100nm/200nm) with top plane Ag without any hole, (2) SiO_2/Ag double layer structure (100nm/200nm), (3) emitter A with top silver film perforated with hexagonal hole arrays, and (4) emitter B with top silver film perforated with square hole arrays, respectively. Also shown in Figs. 4(c) and 4(d) are the theoretical emission spectra by weighted sum of Figs. 4(a) and 4(b) spectra according to the exposed area ratios of the silicon dioxide to silver, i.e., 0.23 to 0.77 and 0.20 to 0.80 for emitters A and B, respectively. By comparing the emission spectra, the tenfold enhancement of thermal radiation at the peak of (1,0) Ag/SiO_2 SP mode was observed. In Fig. 4(d), the peaks at 3.18 and 4.74 μm were attributed to (1,0) Ag/air and (1,0) Ag/SiO_2 degenerate modes, respectively. It is clear that these two peaks were enhanced several times comparing to the theoretical spectra. Obviously the amplification of the thermal radiation is independent of lattices type.

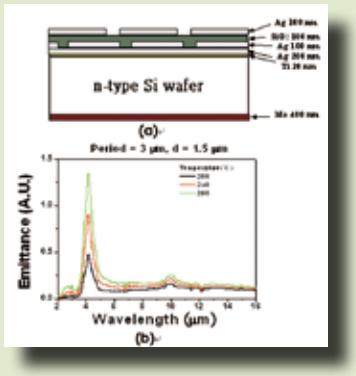


Table 1. Periodic structure parameters for samples A, B, and C, the parameters of lattice constant, hole diameter and side length are a, d and L, respectively. (unit: μm)
表一 對於樣品A, B, C 之週期、排列方式及孔洞大小之參數圖表。(單位：微米)

Sample	Top	a	dorL	Bottom	a	dorL
A	triangular	3	1.5	triangular	3	1.5
B	triangular	3	1.5	square	5	2
C	square	5	2	triangular	3	1.5

Fig. 1 (a) Schematic diagram of the side views of the devices. The periodic lattice arrangement is described in Table Ⅰ. (b) Measured emission spectra at different temperature for device A.
圖一 (a) 元件之側視概略圖　(b) 量測元件A在不同溫度下之熱輻射頻譜。

Table 2. Measured emission peaks position of (1,0) air/Ag and (1,0) SiO_2/Ag for different lattice parameters, the parameters of lattice constant, hole diameter and side length are a, d and L, respectively. (unit: μm)
表二 量測不同元件結構對於(1,0) SiO_2/Ag與air/Ag模態發射頻譜波長之差異。(單位：微米)

Lattice type	a	d or L	(1,0) Ag/air	(1,0) Ag/SiO_2
square	5	2	5.69	7.24
triangular	3	1.5	x	4.16

Fig. 2 Measured emission spectra of device (a) B and (b) C at different temperature.
圖二 分別量測元件B與C在不同溫度下之熱輻射頻譜圖。

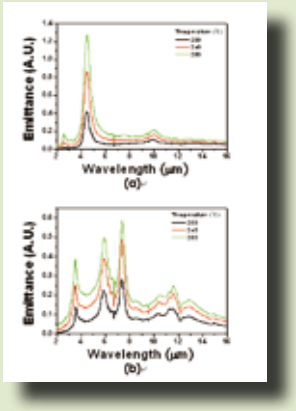


Fig. 3 Schematic diagram of the (a) side and (b) top views of the emitters A and B, the top metal is perforated with hexagonal and square lattice of holes, respectively.
圖三 表示樣品的(a)側視圖(b)分別為樣品A及B之俯視圖，其中包括方型排列或三角形週期排列。

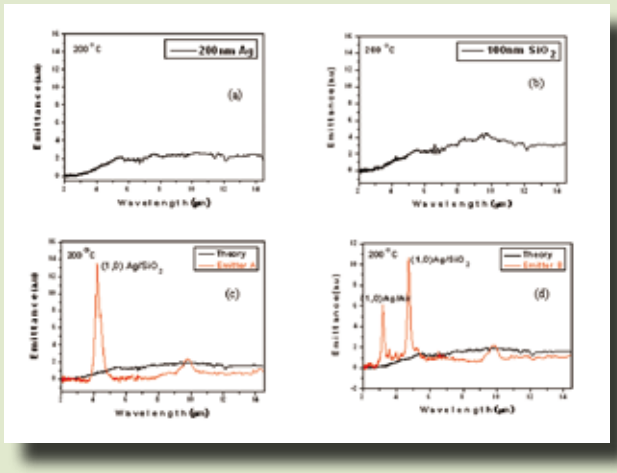


Fig.4 Measured emission spectra of the (a) Ag/SiO_2/Ag tri-layer structure (200nm/100nm/200nm), the top Ag film is plane without any holes, (b) SiO_2/Ag double layer (100nm/200nm), (c) emitter A with hexagonal lattice of holes, and (d) emitter B with square lattice of holes. All the samples were measured at the temperature of 200℃. Theoretical curves are the weighted sum of Fig. 2(a) and (b) according to the exposed area ratio of SiO_2 to Ag, i.e., 0.23 to 0.77 for Fig. 2(c), 0.2 to 0.8 for Fig. 2(d).

圖四 量測熱輻射頻譜圖，分別對(a) Ag/SiO_2/Ag三層結構，厚度分別為(200nm/100nm/200nm)，且上層銀為平整薄膜; (b) SiO_2/Ag雙層結構，厚度分別為 (100nm/200nm) (c)樣品A且為六角週期性孔洞排列 (d)樣品B且為方形週期性排列。所有樣品均在200℃下量測。圖(c)與(d)分別表示樣品A與B的熱輻射頻譜強度相較於同面積下二氧化矽及銀所貢獻之熱頻譜強度。

李枝宏 教授 *Lee, Ju-Hong* , Professor

國立臺灣大學生醫電子與資訊學研究所 教授
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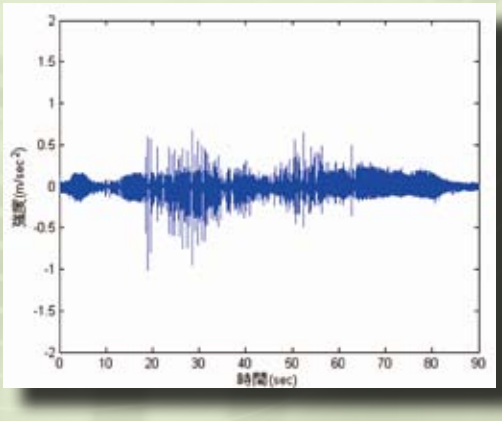
統計信號處理實驗室

Statistical Signal Processing Lab.

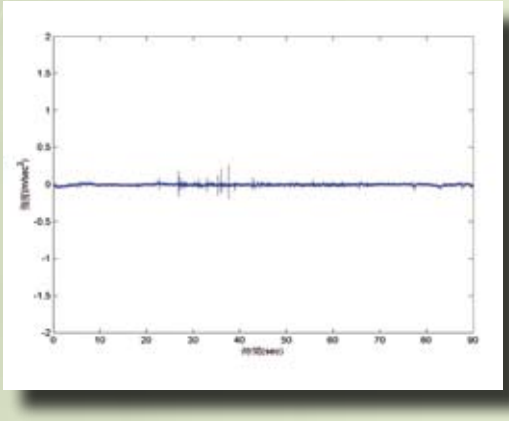
主要研究領域

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

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。



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



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

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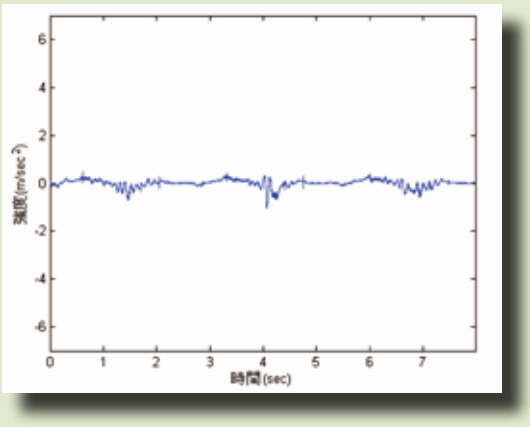
Major Research Areas

Digital Signal Processing, Signal Processing for Smart Antennas and Wireless Communications,
Biomedical Signal Processing, Digital Image Processing

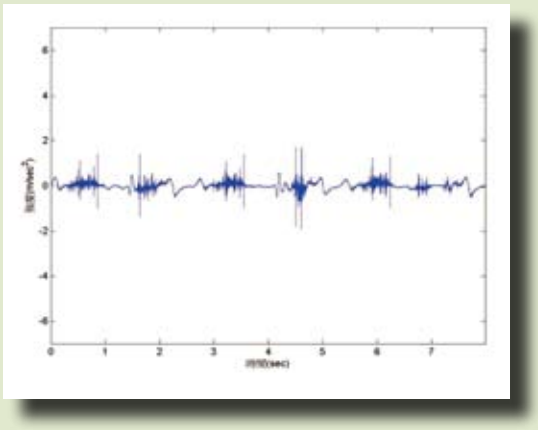
I. BASIC DIGITAL SIGNAL PROCESSING ：
(1) Techniques for the Design and Implementation of 1-D and 2-D FIR and IIR Digital Filters.
(2) Techniques for Design and Implementation of 1-D and 2-D FIR and IIR Digital Filter Banks (Multi-rate Digital Signal Processing)

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

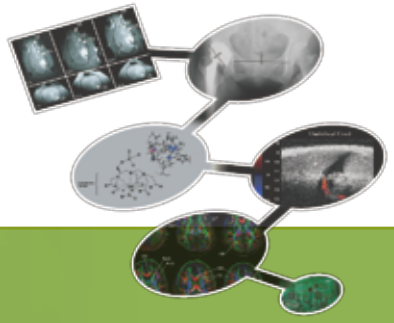
III. PROCESSING AND ANALYSIS OF BIOMEDICAL SIGNALS ：
Analysis and Processing of Joint Vibration Signals for the Diagnosis of Cartilage Pathology
(1) Signal Processing Techniques for Vibration Signals of Human Knee Joints
(2) Signal Processing Techniques for Vibration Signals of Equine Knee Joints
(3)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



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



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



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智慧型及精密運動控制實驗室

IPMC Lab.

主要研究領域

智慧型控制、模糊邏輯、精密伺服控制、超音波加熱治療

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。

Major Research Areas

Intelligent control, Fuzzy logic, Precision servo control, Hyperthermia treatment planning

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.

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研究計畫

1. 智慧型居家看護影像監控系統(II)
2. 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)
3. 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(I)
4. 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
5. 智慧型居家看護影像監控系統(III)
6. 座艙聲紋分析系統之研發
7. 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)
8. 高強度聚焦超音波應用於運動中腫瘤之熱治療探討", 行政院國家科委員會專題研究計劃
9. 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
10. 以影像為基礎之智慧型動作辨識

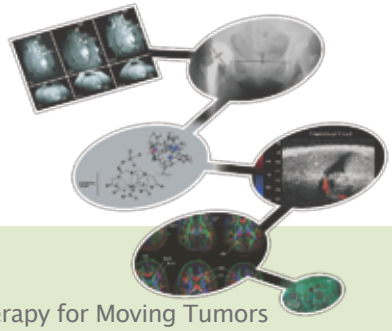
Research Projects

1. Intelligent video surveillance on home care system(II)
2. Effects of HIFU cavitation and nonlinearity on the thermal lesion formation and its applications for thermal therapy(I)
3. Biomimetic snake locomotion and its application to advanced platform actuation systems—master plan
4. Biomimetic snake locomotion and its application to advanced platform actuation systems—sub plan
5. Intelligent video surveillance on home care system(III)
6. Development of voiceprint analytical systems for cockpit voice recorders
7. Investigation of high intensity focused ultrasound for moving tumor thermal therapy
8. The beating effect of confocal ultrasound on the thermal lesion formation
9. Development of HIFU transducer for thermal therapy and surgery
10. Vision-based Multi-target Intelligent Human Motion Identification

計畫名稱：高強度聚焦超音波應用於運動中腫瘤之熱治療探討
補助單位：行政院國家科學委員會
計畫期間：2007/08/01-2010/07/31

高強度聚焦超音波是一種可經由外部將超音波以非侵入方式來加熱治療腫瘤的方法。將超音波聚焦區安置在腫瘤部位，以加熱組織提高其溫度達到燒灼程度以達治療效果。若超音波換能器為陣列型則可經由電子方式來調整各陣元之相位與振幅以改變聚焦點的位置。另外若超音波換能器為單一球狀壓電晶片所構成，則須靠機械方式來移動其聚焦點至所需加熱的部位。由於聚焦超音波所形成的焦點相當小，因而可準確的加熱所要治療區域。由於人體內之內臟器官如肝臟會因呼吸作用而受其他組織器官的擠壓而形成三維空間運動，且其形狀也會隨之改變。因而當利用聚焦超音波來加熱治療此部位的腫瘤時，此一位移及形變會造成聚焦超音波無法準確且持續地將波能導入所要治療區域而造成治療效果降低及傷害到正常組織等不可預期的後果。 本研究計畫所要探討的重點是如何有效利用及時的影像來推測所要治療區之運動模式，進而配合其運動模式將超音波有效的導入所要治療區。

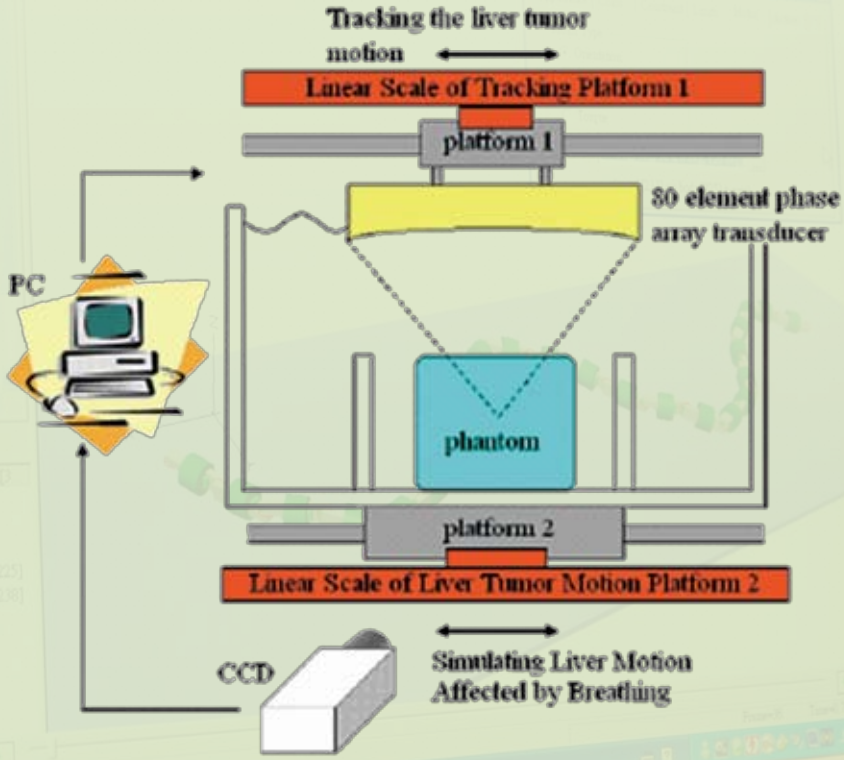
關鍵字：高能聚焦超音波、呼吸運動、運動模式、運動之腫瘤、熱治療、影像



Project Title: Investigation of Extracorporeal High Intensity Focused Ultrasound Thermal Therapy for Moving Tumors
Supported by: National Science Council
Project Period: 2007/08/01 - 2010/07/31

High intensity focused ultrasound is able to deliver the acoustic power into the tumor region to do noninvasive thermal therapy. The focal zone of the ultrasound beam is arranged in the tumor region to raise the tissue temperature up to the thermal surgery level to reach the treatment effect. For a phased array ultrasound transducer, it is able to move the focal zone by tuning the amplitude and phase of each element of the array. While for a single spherical ultrasound transducer, a mechanical motion control system is required to have the focal zone arranged in the desired treatment region. The focal zone formed by the high intensity focused ultrasound transducer is small, and hence it is able to do accurate thermal therapy. The internal organ may move due to the respiration or others, and its motion is three-dimensional and its shape is also variable. As the high intensity focused ultrasound is employed to do thermal therapy for the tumors located in these organs, the motion and shape variation will have a significant effect on the lesion formation and reduce the treatment result and have damage the normal tissue unpredictably. The research project is investigating how to use the real time imaging of the desired treatment region to predict its motion pattern and then deliver the acoustic power to the region effectively by using the predicted motion pattern.

Keywords: high intensity focused ultrasound, respiration, motion pattern, moving tumor, thermal therapy, imaging.



Experiment platform structure. Platform 1 and 2 are able to move by 2 serve motor. Platform 1 tries to track platform 2. The image process and prediction is calculated in the same PC.

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國立臺灣大學電機工程學系 教授
國立臺灣大學醫學工程學研究所所長

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

醫學影像、核磁共振影像頻譜、生醫分子影像核心實驗室

Medical Imaging Lab., Magnetic Resonance Imaging Lab., Biomedical Molecular Imaging Core Lab.

主要研究領域

核磁共振影像、醫學工程

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：

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。

生醫分子影像核心實驗室：

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臺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。

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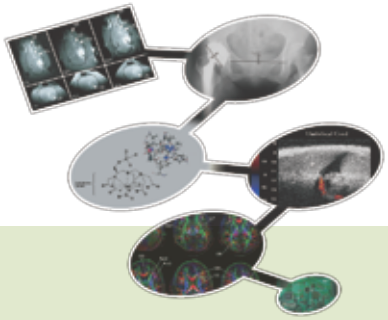


Major Research Areas

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

Magnetic Resonance Imaging Lab.：

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.

Biomedical Molecular Imaging Core Lab.：

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.

研究計畫

1. 大腦功能影像技術平台建立
2. 發展動態顯影及具標定功能之生醫分子磁振影像:評估肺癌之腫瘤生成、轉移、血管新生及治療反應-針對肺癌診斷與治療評估之核磁共振分子影像技術平台:具標定功能氧化鐵奈米粒子之發展
3. 新世代磁共振成像術之研發II-超高速磁振成像系統之研究：以寬頻無線通訊理論建構之新世代MRI(子計畫一)
4. 大腦神經連結與功能之定量化研究：以CRMP-1基因剔除小鼠為模型
5. 人類認知、神經機制與社會運作的共建歷程-子計畫六：人腦功能定位的先進磁振造影技術發展
6. 基因體醫學研究中心

Research Projects

1. Evaluation of tumorigenesis, metastasis, angiogenesis and therapeutic response of lung cancer in mice model with dynamic contrast perfusion MR Imaging and targeted MR molecular imaging
2. Program for Promoting Academic Excellence of Universities（Phase II）: Development of An Ultrafast MR Imager: A New Generation MRI Based on Broadband Wireless Communication Theory
3. Co-construction of Human Cognition, Neural Mechanism, and Social Process - Advanced fMRI Technologies Development for Human Brain Mapping
4. Program for Excellence Research Teams：NTU Center for Genomic Medicine - Biomedical Molecular Imaging Core Lab

計畫名稱：人類認知、神經機制與社會運作的共建歷程：人腦功能定位的先進磁振造影技術發展
補助單位：行政院國家科學委員會
計畫期間：2007/04/01-2008/04/31

作為整個功能性認知技術發展卓越計畫之核心，本子計畫著重於建立一個世界級功能性核磁共振照影成像中心，提供技術研發，以促進國內之神經認知與功能影像研究。在這幾年當中，我們致力於建構一個高品質功能性磁振照影實驗環境，以提供認知心理學研究與發展。此外，我們也進行了一些基礎與應用的研究，發展一些能夠增進認知與神經研究的技術，包括建構一個轉屬於台灣人之大腦影像圖譜，定量化功能性磁振影像之研究，自動化之噪音抑制系統…等。這些研究成果能夠提供心理學研究，生理學研究，與醫學方面之良好的研究環境與促進其研究發展。在人類的研究方面，我們有發表一些於語言，注意，與聽覺疾病上的研究；於動物方面，我們也有痛覺方面的一些成果。我們最終的目標在於建構一個領先世界標準之卓越功能性核磁共振照影實驗室，為神經與認知研究提供技術之發展與支援。

Project title: Co-construction of Human Cognition, Neural Mechanism, and Social Process: Advanced fMRI Technologies Development for Human Brain Mapping
Supported by: National Science Council
Project period: 2007/04/01-2008/04/31

As the technical core of entire project for functional neuroimaging of cognition, the main purpose of this subproject is to provide world-class functional MRI capability for cognitive research. In the past two years, we devoted our resources to develop high quality fMRI studies for brain activities studies, as well as to establish an optimized environment for cognitive psychological experiments in MRI. In addition, we also initiated a variety of applications and fundamental works for fMRI research, including the creation of Chinese brain template and fMRI database system, quantitative fMRI techniques, active noise cancellation system, simultaneous recording system …and so on. The result outcomes of this sub-project not only supported fMRI studies in the excellent project, but also provide better experimental environments for other researchers, including psychologists, physiologist and medical doctors. For examples, we have published some fMRI studies related to several topics including language, attention, auditory plasticity in human, and pain perception in animal. Our goal is to establish an excellent fMRI research center which achieves and exceeds the international standard.

a.

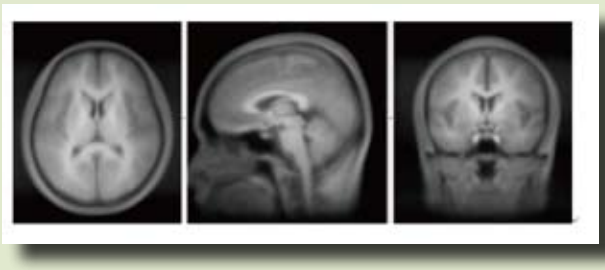


Figure a.) The three orientations of NTU Chinese brain template which was acquired from 95 normal participants aged from 18 to 35 years old.

Figure b.) The fMRI result of simultaneous visual and auditory task which is normalized into western, MNI, template (left) and into NTU Chinese brain template (right).

b.

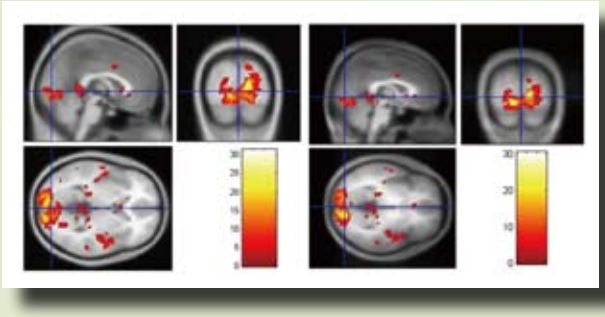


圖 a.) NTU台灣人大腦圖譜的三個切面，其圖譜影像由95個受試者平均而得之。

圖 b.) 將同時給予視覺與聽覺刺激之實驗數據，對位到不同之大腦圖譜(左:西方人之圖譜，右:自行研發之NTU台灣人之大腦圖譜)，分析出來的反應區域有明顯之差異。

管傑雄 教授 *Kuan, Chieh-Hsiung* , Professor

國立臺灣大學生醫電子與資訊學研究所 教授
國立臺灣大學電機工程學系 教授

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

紅外線暨生醫奈米元件實驗室

Infrared and Bio-Chemical Nano-Device Lab.

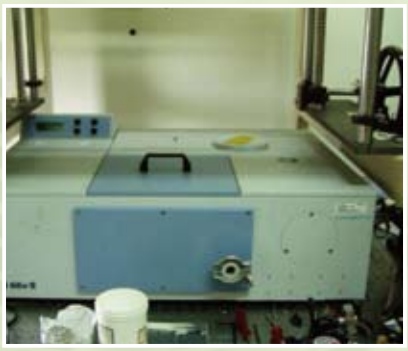
- 電子束直寫顯影實驗室、電子束掃瞄及顯影實驗室
  Direct-Writing Electron Beam Lithography System Lab, Scanning Electron Microscope Lab.
- 微拉曼/光激發光 光譜實驗室 Micro-Raman/PL Spectral Lab.
- 紅外線光譜實驗室 Infrared Spectral Lab.

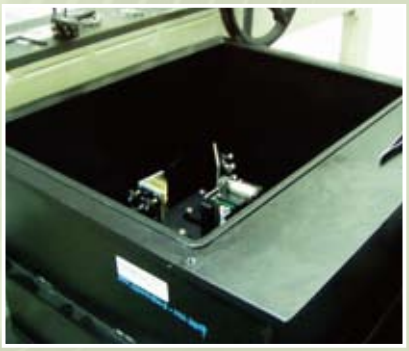
主要研究領域

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

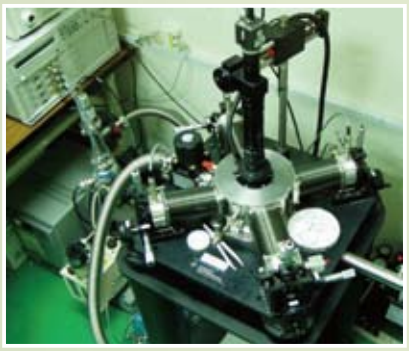
Major Research Areas

Optoelectronic Device, Noise Measurement, Nano-Electronics, Bio-medical Chip, Raman Spectral Analysis, Optical Detection of Ultra-Rare DNA by Raman





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

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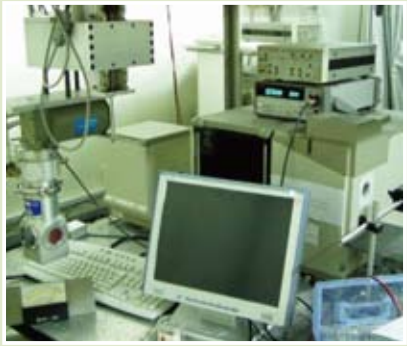
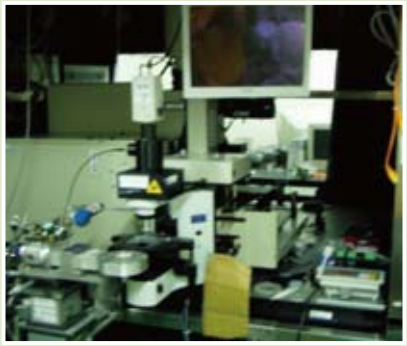


FTIR 紅外線光譜儀



T 64000微光譜量測系統

電子束微顯影系統

研究計畫

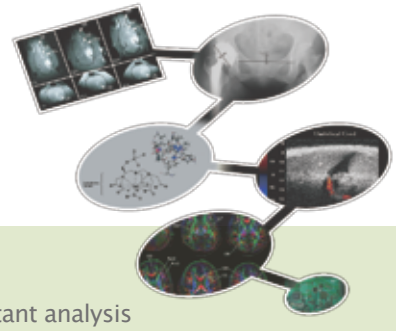
1. 矽鍺量子點奈米級記憶元件及陣列之製作與研究
2. 可低偏高溫操作且正向頂面入射的超晶格紅外線偵測器及陣列的研發
3. 光譜與電性量測於基因篩選之應用

Research Projects

1. Nano-scale SiGe quantum-dot memory and array
2. Development of the Superlattice Infrared Photodetector and Array for Low-Bias High- Temperature Operation and Top Normal Incidence of Light
3. Application of spectrum and electrical signal measurements on gene screening

計畫名稱：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
補助單位：行政院國家科學委員會
計畫期間：2007/08/01 - 2010/07/31

我們以傳統半導體製程設計微電泳通道元件，初期先對一般生物分子如短片段DNA作量測，待技術成熟再將來自人體之正常與異常之基因序列及蛋白質片段，在此新技術下比對。我們採用交用訊號量測方式使量測環境形成規律之充放電反覆循環，避免電荷持續累積，並確保量測環境不隨時間改變，以將雜訊成分降到最低，同時可大幅提高訊號／雜訊比。藉由生物分子在交流響應中表現出來的相位延遲現象，精準擷取出複數形式的響應參數，再將此同一機制下產生之虛部除以實部，得到各種不同生物分子的特徵響應值，中間包含生物分子相位延遲響應的資訊。這種以搭配高頻低雜訊前置放大器而建立的鎖相放大器量測系統進行之量測，可實現高敏感度，依此構想期望研發一種新型生物分子ID建立方式。本計畫已初步成功架設一套鎖相放大器量測系統來精準量測微電泳晶片的訊號，並且創新式的提出以交流電訊號來分析生物分子微電泳響應的新方法，從目前的實驗結果已經足夠証明當初所預期的一些重要的現象，如高重複性、低誤差率的量測結果等。並且初步驗證了交流電分析的可行性及其所獨具的各項優點，如充放電反覆循環的優點使量測環境不隨時間改變，所以這種晶片可做為長時間的分析應用，比一般的微電泳晶片更能節省樣本消耗。另外從交流電分析取得的複數形式的響應數據，本研究準確量測出生物分子在微電泳中的相位延遲資訊，並從這些資訊我們也定義了不會隨量測環境改變的生物分子之特徵響應值。同時我們也建立了離子運動的理論模型來研究生物分子的交流電泳響應，在經過此理論的電腦模擬與實際實驗結果的比對，我們也發現出生物分子的交流響應擁有模型化的可行性。



Project title: High-sensitivity AC electrical signal measurement and infrared spectrum assistant analysis
Supported by: National Science Council
Project period: 2007/08/01 - 2010/07/31

Our microelectrophoresis channel devices are fabricated in semiconductor fabrication process. First we focus on measurement of general biomolecules, like oligonucleotides. Then we try to apply on analyzing and compare DNA and protein from both normal and abnormal gene sequences. We use AC signal measurement which can lead to regular charge recycling in micro-channel and avoid charge accumulation in the measurement environment. It ensures that the lowest noise exists in this environment and therefore increase the signal-to-noise (S/N) ratio. By measuring the phase delay phenomenon of bio-molecular under AC signal response, we can acquire data in a form of complex number. We can also calculate the individual response by dividing imaginary part with real part, both signals generated in the same mechanism. This measurement system implemented a lock-in amplifier with high frequency low noise pre-amplifier in advance and which can measure signals with high-sensitivity. We expect to develop a novel bio-molecular ID establishment from this new idea.In the project, we have successfully established a lock-in amplifier systems focus on biomolecular AC measurement, and also demonstrated a new model and related method to analyze the biomolecular AC signal response. Although the present data amount are not very much enough, it is sufficient to prove some important phenomena like highly repeatable and low error range of the present experimental results. And we ensure the advantages of charge recycling effect remains measuring environment doesn' t change with time, so this type of biochip can be applied in long time analysis, and decrease wasting of samples.The complex form of response signal acquired from AC measurement. Our research precisely obtained the information of phase delay in microelectrophoresis and defined the environment-independent characteristics response. At the same time, we also established the theoretical model of ion movement to study biomolecular AC response. After comparing the computer simulation and real experimental data, we found out the capability in modeling the biomolecular AC response.

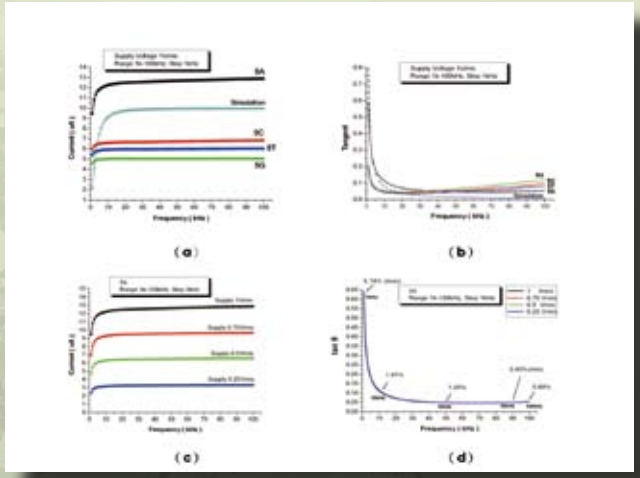


Fig.(a) shows the AC current responses of four nucleotides(5A.5T.5C and 5G).The results are highly repeatable, which are much better than the results of conventional DC microelectrophoresis. The current and phase responses of experimental results are both conform to the theoretical model tendencies

(Fig.(a).(b)).By adding variant voltages to the same molecule, the steady-state current and phase response are also fit the theoretical model. We expected that the novel environment-independent AC measurement extremely possess the potentials of development.

【代表圖】：圖（a）顯示四種核苷酸分子（5A、5T、5C、5G）電流之交流響應圖，其高重複性較傳統直流微電泳的結果佳【誤差統計見附表一】；而不論在電流和相位數據上，其趨勢均與本實驗之理論推導相符合

【（a）、（b）】（理論推導結果簡述於最後）；而在（c）、（d）的結果顯示針對同一種核苷酸分子，外加不同電壓作量測，其穩態電流與相位響應等趨勢均與理論推導相符，預期此種「與環境無關」之新型AC檢測極具發展潛力。

鍾孝文 教授 *Chung, Hsiao-Wen* , Professor

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國立臺灣大學電機工程學系 教授

Professor, Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University
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醫用磁振造影實驗室

Magnetic Resonance in Medicine Lab.

主要研究領域

醫用磁振造影

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14名，碩士班研究生5名。博士班畢業生十名，碩士班畢業生十名。目前進行中的研究主要有以下幾項：

1. 螺旋槳式面迴訊擴散磁振造影
   螺旋槳式面迴訊成像技術為適合高磁場（如3.0 Tesla）下之高解析度的腦部擴散影像技術。本計畫預期配合陣列線圈平行影像與反梯度面迴訊影像幾何校正等幾項改良方式，以求進一步減低面迴訊中之幾何扭曲，並拓展至臨床應用。

2. 平衡穩定態自由旋進磁振造影
   平衡穩定態自由旋進為新興之高效能高信雜比快速磁振造影技術，多使用於心臟造影中。本計畫將拓展此技術，以多頻率葉片式內插混成技術，針對事前選擇之特定區域從事對比之最佳化，並應用於高解析度神經系統功能性造影。

Major Research Areas

Biomedical magnetic resonance imaging

Founded in July 2000. Supervisor: Prof. Hsiao-Wen Chung. This lab currently (2007) has 14 Ph.D. students and 5 M.S. students, plus 10 Ph.D. graduates and 10 M.S. graduates. Research topics include:

1. Propeller echo-planar diffusion MR imaging
   Propeller EPI is a technique suitable for high-resolution diffusion imaging in the brain at high fields such as 3.0 Tesla. This project aims to integrate parallel imaging and reverse gradient methods to further reduce the geometric distortions in EPI, such that it can be applied to clinical routines.

2. Balanced steady-state free precession MR imaging
   Balanced SSFP is a rapid SNR-efficient MR imaging technique mostly used in cardiac imaging. This project aims at high-resolution functional imaging in the central nervous system by means of multi-frequency interleaving to optimize functional contrast in specific regions of interest.

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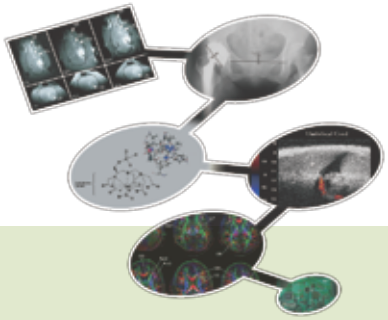


研究計畫

1. 快速穩定態磁振造影及其臨床應用之進階研究
2. 螺旋槳式面迴訊擴散磁振造影

Research Projects

1. Advanced investigations on rapid steady-state free precession MRI and clinical applications.
2. Propeller echo-planar diffusion magnetic resonance imaging.

計畫名稱：平衡穩定態磁振造影之功能性神經影像
補助單位：行政院國家科學委員會工程處
計畫期間：2007/08/01-2010/07/30

本計畫為三年期前瞻性研究。重點在於針對極小角度之平衡穩定態磁振造影（BOSS），研發一系列可突破實驗瓶頸之關鍵技術、探討空間解析度與平行影像暫態信號響應、並以高解析度實驗驗證技術研發之潛在優勢，從而應用於高磁場（3.0 Tesla）無幾何扭曲的大腦功能性磁振造影。三年間計畫之特定目標為：

一、發展出多頻率葉片式內插混成技術，以增寬BOSS fMRI 之空間涵蓋度。並研發切面性頻率調整法，針對事前選擇之特定區域從事功能性對比之最佳化。本階段將以視覺皮質刺激實驗結果技術發展之優勢。

二、以高解析度（像素寬度小於0.5mm）視覺BOSS fMRI 探討空間解析度對於資訊特異性、信號雜訊比、以及功能性對比之影響。並進一步以平行影像加速掃瞄，同時探究暫態響應信號之功能性影像表現。

三、以研發完成之高解析度無扭曲BOSS fMRI 進行：（一）左右眼視覺之大腦皮質功能活化區分野實驗，與（二）不同手指運動之雙側大腦皮質功能活化區分野實驗，由此驗證BOSS fMRI 技術發展之重要性與優勢潛力。本計畫之預期成果，較之現行常用之面迴訊影像，將能有效提高腦功能磁振造影在探討細部活化區方面之可行性；較之以往穩定態成像法，則得以增寬空間涵蓋率、並提高實驗穩定度。因而得以協助未來神經功能影像之進一步拓展。

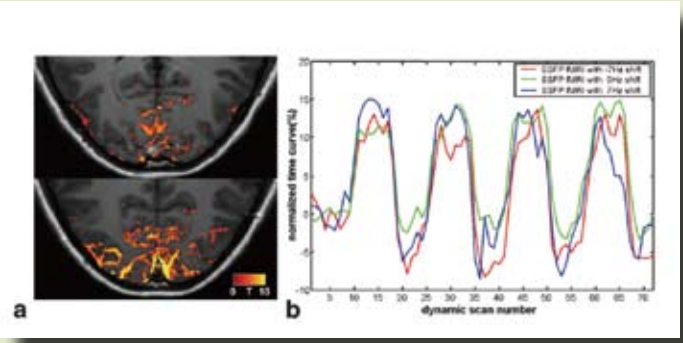
Project title: Balanced steady-state free precession MR imaging techniques for functional neural imaging
Supported by: National Science Council, Engineering Division
Project period: 2007/08/01-2010/07/3

This is a three-year prospective project aiming at the exploration of distortion-free techniques for blood-oxygenation-sensitive steady-state (BOSS) functional MRI (fMRI) of the brain at 3.0 Tesla. We shall attempt technical developments to increase experimental robustness, investigate the signal behavior under different conditions, and perform high-resolution fMRI experiments to demonstrate the unique advantages of BOSS fMRI. Chronologically, the specific aims are:

1. We shall develop a multi-frequency interleaving method to widen the spatial coverage of BOSS fMRI, and a slice-dependent frequency adjustment method to optimize the functional contrast with respect to the pre-selected region of interest. Experiments using visual stimulation will be performed to visualize the technical advantages.

2. We shall explore the effects of spatial resolution on the information specificity, signal-to-noise ratio, and functional contrast in BOSS fMRI by performing visual fMRI at in-plane pixel width of 0.5mm or smaller, plus a further increase in temporal resolution using parallel imaging along with a comprehensive investigation of transient-state signal behavior.

3. We shall attempt the application of distortion-free high-resolution BOSS fMRI to examine the activation patterns in (1) ocular dominance column using visual stimulation to left and right eyes separately, and (2) bilateral motor cortex activation upon movement of different fingers, to fully explore the overall benefits of technical improvements in BOSS fMRI. Compared with EPI-based fMRI, the anticipated results from this study should substantially increase the feasibility of detailed structural examination of the fine activation pattern. Compared with current steady-state-based fMRI, the anticipated results from this project should widen the spatial coverage with increased experimental robustness. The overall advantages in BOSS fMRI provide strong potential enhancing future neural functional imaging.



Maximum intensity projection combination of the high-resolution brain functional activation maps from visual stimulation experiments using three interleaved frequencies, showing activation regions located exactly on the microvessels in the sulci (a).

The activation signals for the high-resolution experiments reached the level of 15% for all trials, reflecting the effectiveness of partial-volume reduction by high-resolution BOSS fMRI with the infinite-impulse-response-filtered frequency stabilization (b).

（左圖 a）由葉片式頻率混成、經由最大亮度投影合併三次實驗所得到的高解析度視覺刺激腦功能活化區圖譜，顯示出功能活化區域均精確對位於腦溝處之小血管。
（右圖 b）功能性活化信號靈敏度在每次實驗中都達到15%，反映出以 IIR 濾波器作為頻率穩定技術後所達成之高解析度影像得以有效減低部分體積效應。

林啟萬 教授 *Lin, Chii-Wann*, Professor

國立臺灣大學生醫電子與資訊學研究所 教授
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Professor, Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University
Professor, Department of Electrical Engineering, National Taiwan University

醫用微感測器暨系統實驗室

Medical Micro Sensor and System Lab.

主要研究領域

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

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。

Major Research Areas

Bioelectronics, Biomedical Micro sensors and System, Biochip, Biomedical Optics, Artificial Neural Networks, Regulatory Affairs

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.

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研究計畫

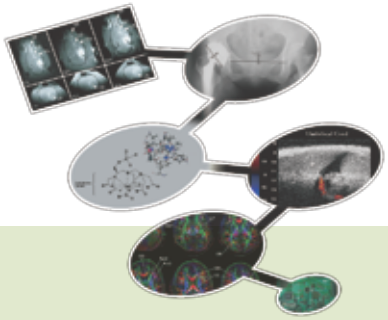
1. 光生化型晶片系統於藥物篩選與疾病檢測之研發
2. 光生化型晶片系統於藥物篩選與疾病檢測之研發 – (子計畫二)整合式蛋白質生醫晶片系統
3. 分子交互作用統計行為之奈米陣列量子晶片設計
4. 整合式奈米氣體陣列感測器於有毒氣體分析之研發
5. 先進無線生醫保健監測系統之開發三年計畫第2期計畫
6. 即時性可拋式軟性有機電激表面電漿子生物感測元件 (總計畫)
7. 非線性光學顯微術於奈微米尺度下生物分子動態檢測之研發
8. 以海鱸、海藻及濾食性貝類整體育種、飼養、銷售、智慧財產保護平台之海產食物供應鏈研究－
   子計劃六：智慧財產權佈局與品質安全規範研析
9. 永續智慧人本住家(子計畫二)-居家醫護屋

Research Projects

1. Drug Screening and Diseases Diagnosis with Multifunctional Opto-electronic Biochip Systems
2. Integrated Protein Chip System
3. Design of Quantum Nano Array Biochip for Stochastic Molecular Interactions
4. Integrated gas nanosensor array for the analysis of volatile mixtures
5. Wireless Health Advanced Monitoring Bio-Diagnosis , WHAM-BioS (Phase II)
6. Disposable Soft Material-based OLED SPR Biosensor for Real Time Applications (Co-PI)
7. Nonlinear microscopy developments for investigations of biomolecules in micro- and nanodomains(Co-PI)
8. Sea food supply chain – Analysis of Intellecture Propertis & Regulatory affairs(Co-PI)
9. Development of a smart sustainable human-centric home- Smart Medical Home(Co-PI)

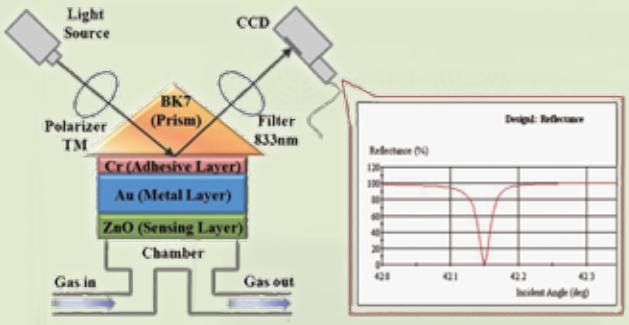
計畫名稱：整合式奈米氣體陣列感測器於有毒氣體分析之研發(2/3)
補助單位：行政院國家科學委員會
計畫期間：2007/08/01-2008/07/31

本計畫第二年除了接續第一年感測薄膜的發展，另外，對於微小型感測系統也持續努力。與加拿大合作的三氧化二鎢感測薄膜持續於理論於光學性質的探討。氧化鋅感測薄膜部分著重於製備氧化鋅奈米結構及探討氧化鋅奈米柱及奈米薄膜分別在電阻式及表面電漿氣體感測上之應用。我們利用水熱法在金柵狀電極上成長奈米柱，並且利用不同成長次數控制奈米柱之長寬比；當成長次數從一次增加到四次時，氧化鋅奈米柱之長寬比由原本10增加到33。根據結果顯示，長寬比為10的奈米柱在操作溫度240度下有最佳的靈敏度，並且其偵測下限可降到2 ppb，符合氣喘診斷所需之感測範圍。為了探討人類呼氣中氣體成分中二氧化碳及氧氣的干擾，我們將一氧化氮分別與此兩氣體混合後進行偵測，結果顯示當一氧化氮於氧氣及二氧化碳共存時，感測器的訊號受到很大的干擾。另一方面，我們藉由調控氧化鋅薄膜厚度來調整表面電漿訊號，我們發現20奈米的氧化鋅薄膜具有最佳的表面電漿共振之訊號。而在一氧化氮氣體感測方面，在操作溫度150度下，氧化鋅薄膜之表面電漿氣體感測器之偵測下限可到100 ppm。

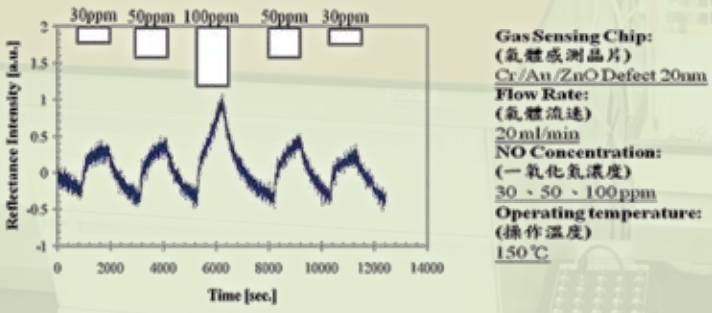


Project title：Integrated gas nanosensor array for the analysis of volatile mixtures(2/3)
Supported by：National Science Council
Project period：2007/08/01-2008/07/31

Despite continuing the development of sensing film in the first year, this project also devoted into miniature the sensing system fitting for the portable purpose. There are two kinds of sensing thin films for NO gas made of zinc oxide and tungsten oxide. The optical properties of thin film with tungsten oxide doped with gold are still explored and co-worked by NTU in Taiwan and NRC in Canada. In the part of ZnO, the nanostructured ZnO films were fabricated and their application to Chemiresistive-type and SPR-based gas sensor was investigated. The ZnO nanorods were grown by the hydrothermal method onto a ZnO thin film (~150 nm), which was designated as the ZnO thin film/ZnO nanorods. The ZnO thin film was pre-sputtered on the Au interdigitated electrode. By repeating the growth in a fresh precursor from one cycle to four cycles, the aspect ratio of the nanorods increased approximately from 10 to 33. For chemiresistive NO gas sensor application, however, the sensitivity decreased as the aspect ratio of the ZnO nanorods increased. It' s very likely that higher density and higher aspect ratio of ZnO nanorods prevent NO gas from penetrating into the ZnO nanorods. The optimal operation temperature for the ZnO thin film/ZnO nanorods with an aspect ratio of 10 was found to be 240 oC for sensing NO gas. The limit of detection reached 2 ppb which is applicable for asthma diagnosis. To simulate human breath, cross-sensitivities with respect to CO2 and O2 have been tested. The responses of ZnO nanorods based gas sensor to NO gas were greatly decreased as the NO gas coexisted with either O2 or CO2. On the other hand, the ZnO film thickness for SPR NO gas sensor was optimized and was found to be 20 nm. The limit of detection for the SPR gas sensor based on ZnO film is 100 ppm at the working temperature of 150 oC.



The sketch map of SPR measuring system（SPR 氣體量測系統示意圖）



Shift of the surface plasmon resonance due to subsequent N2/NO cycles
(於NO 氣體通入後之光反射強度動態量測曲線)

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Adjunct Professor, Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University
Adjunct Professor, Department of Electrical Engineering, National Taiwan University
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生物醫學信號實驗室

Biomedical Signal Lab.

主要研究領域

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

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，並合力執行多項獲行政院國家科學委員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功能性電刺激器，另致力於多主多從(M3S)的輪椅安全規範的研究，亦有所成，現已完成符合多主多從規範之完整硬體系統，並多次進行臨床實驗且通過輪椅安全性之驗證。

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。

Major Research Areas

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

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 FES system, the paraplegics or hemiplegics with serious disabilities have greatly progressed in their activity in daily life. Our lab also devoted to research of multiple masters and multiple slaves (M3S) mechanism for caring the disabled with wheelchairs. A complete and working M3S safety wheelchair had accomplished and passed many clinical testing

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.

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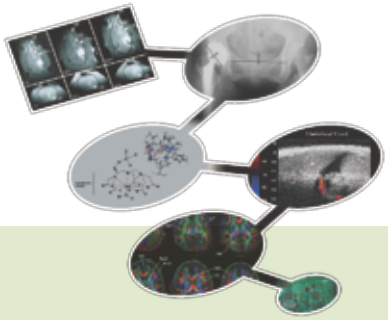
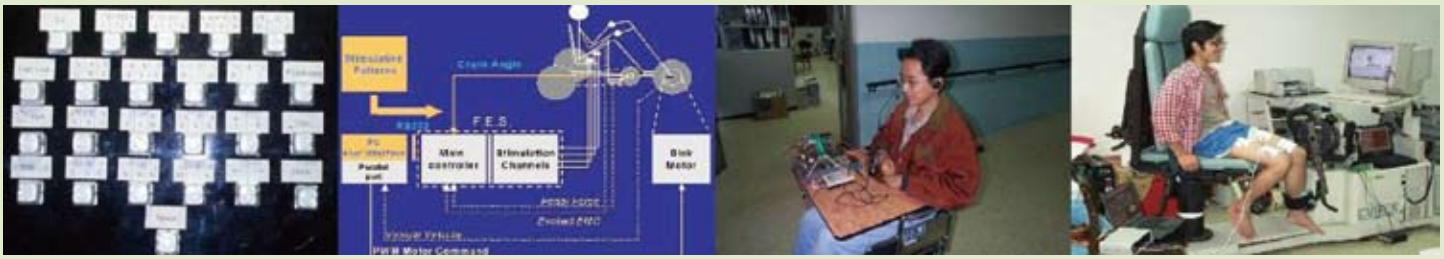


研究計畫

利用RFID技術預防尿失禁患者併發症可行性之探討

Research Projects

Feasibility Study of the Prevention of the urinary incontinence patient's complication using RFID Technique



計畫名稱： 上肢遠距復健醫療系統之研發與應用
補助單位： 行政院國家科學委員會
計畫期間： 2007/08/01-2008/07/31

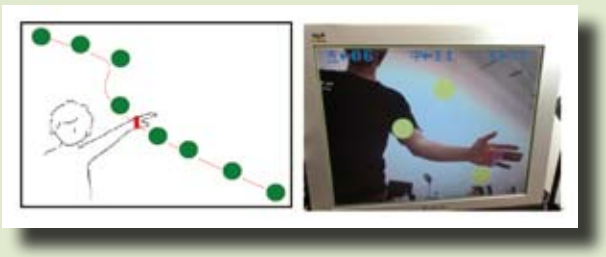
利用電腦科技給予需要復健的患者不同的治療是目前已經發展中的趨勢。然而由於成本的昂貴使地沒有辦法大量普及。因此本計畫將開發之平價上肢遠距復健系統，以有效降低患者留院進行治療的時間，並且可提高其療效。此外，患者在家中自行進行復健的結果將透過網路安全機制傳至醫院端給予醫療人員，以評估療效，並且給予線上指導。

Project title: The Development and Application of Telemedicine and Assistive Technology for an Upper-limb Rehabilitation System
Supported by: National Science Council
Project period: 2007/08/01-2008/07/31

The utilization of computer technology has been a trend in the development of treatment approaches regarding those who require rehabilitation. Nonetheless, the surprising high cost has reduced the popularity of such equipments. Our project is therefore aimed at the development of an affordable tele-rehabilitation system, such that the treatment required within a hospital can be greatly reduced. In addition, outpatients can also deliver the results of a self-assisted rehabilitation program through privately secured internet to medical personnel, such that the information can be assessed to provide further online instructions.

The illustrations of upper limb abduction rehabilitation

The foregoing figures illustrate a tailored computer game that assists frozen shoulder patients in the practice of adduction and abduction at home for the recovery of abilities to be performed in daily activities.



本圖顯示為五十肩患者設計的上肢復健遠距復健醫療系統，透過與電腦遊戲互動的方式來鼓勵患者進行居家復健療程，可加速恢復其日常生活能力。

王唯工 兼任教授 ***Wang, Wei-Kung*** , Adjunct Professor

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Adjunct Professor, Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University
Adjunct Faculty, Institute of Physics, Academia Sinica

非侵入式生理量測實驗室

Non-Invasive Physiological Measurements Lab.

主要研究領域

非侵入式生理量測

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。

Major Research Areas

Non-invasive physiological measurement

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.

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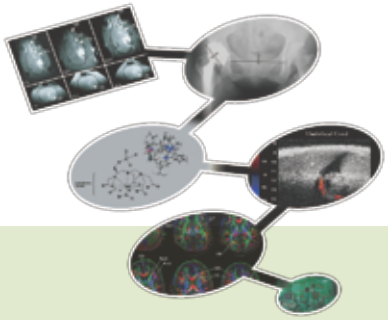


研究計畫

1. 非侵入性生理量測血液成份如血糖、血氧
2. 中醫基礎與脈診研究
3. 減少二氧化碳產生之食品與塑身研究
4. 遠距醫療服務之研究

Research Projects

1. Non-invasive means to study blood ingrediences . Such as Glucose , Oxygen.
2. Pulse-feeling and fundation of Chinese medicine.
3. Food to reduce CO2 production and body Casting.
4. How to provide these services through Web.

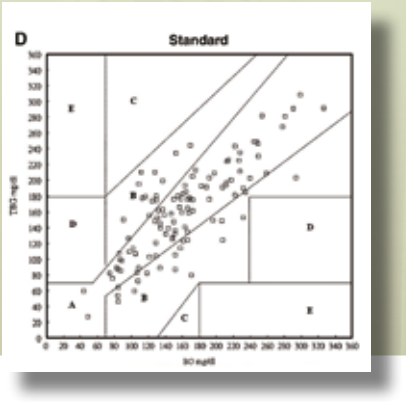
計畫名稱：非侵入式血糖監視儀
補助單位：Tangtest股份有限公司
計畫期間：2003-2010

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

Project title: Non-invasive blood glucose monitoring
Supported by: Tangtest Co. USA
Project period: 2003-2010

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, whic 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



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.

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)

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整合神經生理學實驗室

Integrative Neurophysiology Lab.

主要研究領域

神經生理學、感覺神經生理學

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。

Major Research Areas

Neurophysiology, Sensory physiology

研究計畫

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

Research Projects

NO-mediated electroacupuncture-induced urethral reflex potentiation and the intracellular messenger pathways involved

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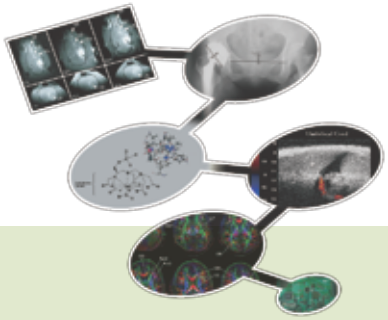

計畫名稱：一氧化氮媒介之電針刺激-引發尿道反射增益現象及參與之細胞內訊息傳遞路徑
補助單位：行政院國家科學委員會
計畫期間：2007/08/01-2007/07/31

臨床已廣泛應用針刺(Acupuncture) 引發體-臟器反射(somato-visceral reflex) 的機制來改善各種臟器功能，例如針刺或電刺激特定穴位(如八穴、關元、中極、子宮、太谿及三陰交等)，可以透過腰、薦髓層次體傳入神經之興奮，而達到改善骨盆底生殖泌尿功能異常的效果，但目前對相關反射傳導路徑的細胞機制所知有限。近年本實驗室發現，以1 Hz 頻率重複通電刺激大白鼠子宮穴位深處腹肌，發現尿道外括約肌的肌活動性不斷增加，推測此種神經突觸活性增強的現象(尿道反射增益現象；urethral reflexpotentiation, URP)，是膀胱儲尿期關緊尿道使尿液禁制(contience) 的重要機制。本研究計劃預計以麻醉大白鼠為實驗動物，利用電針刺激來建立URP 的實驗模式，並探討相關細胞內訊息傳遞路徑及應用價值。

第一年：以1 Hz 頻率重複通電刺激大白鼠子宮穴深處腹肌，誘導URP 形成後，經由椎管內分別注射麩胺酸接受器的拮抗劑(NBQX 及APV)；或在基本反射活性(1/30Hz 頻率不會引發URP) 時，由椎管內分別注射麩胺酸接受器的致效劑(Glutamate 及NMDA)，觀察外尿道括約肌產生動作電位數之變化；同時比較兩種頻率的電針刺激下，L6~S2 脊髓組織中一氧化氮合成酶(已知與中樞神經突觸塑性的形成有關) 表現量的變化。預期第一年的實驗可建立“重複性電針刺激誘導麩胺酸-依賴型URP”的實驗模式，而且與NO 的生成有關。第二年：沿用第一年的實驗模式進一步證實“麩胺酸-依賴型URP”的建立，與胞內CaMK / NO / sGC / PKG (Calmodulin kinase / nitric oxide / soluble guanylyl cyclase / protein kinase G) 訊息傳遞路徑的活化有關，阻斷路徑中任何物質的活化，將會抑制麩胺酸-依賴型URP 的形成。希望藉由第一、二年的實驗結果，不但能釐清誘導URP 的胞內訊息傳導路徑，亦可應用於臨床閉鎖尿道的訓練，應該有助於應力性尿失禁症狀的改善。第三年我們將利用環磷胺(Cyclophosphamide; CP) 灌注大鼠膀胱，誘發膀胱發炎的實驗動物模式後，觀察上述NO 媒介之URP 的變化，預期CP 長時間擴張膀胱，造成NO 過度生成，將使增益現象的程度顯著增大。我們推測臨床長期使用CP 來抗癌或當免疫抑制劑的病人，若能配合適當降低NO 作用的處理，應可降低得到CP-誘發出血性膀胱炎副作用的機會。

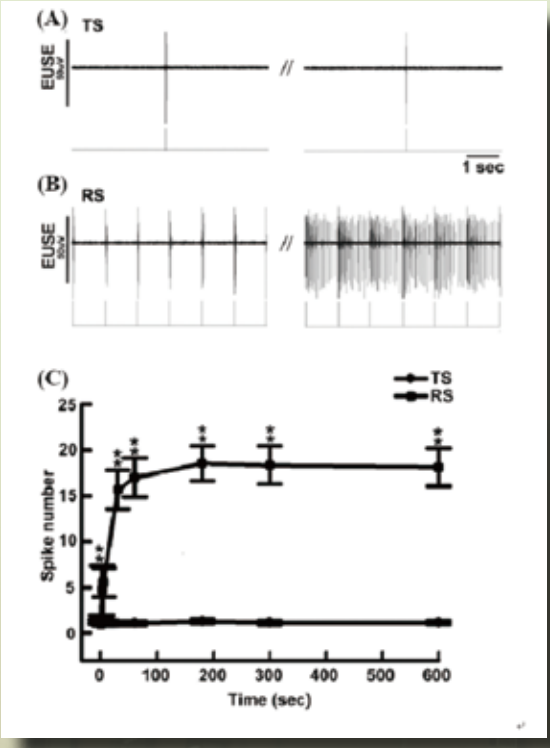

Illustration of test stimulation (TS) and repetitive stimulation (RS) induced pelvic-urethral reflex activity.

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。

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)

Project title: NO-mediated electroacupuncture-induced urethral reflex potentiation and the intracellular messenger pathways involved
Supported by: National Science Council
Project period: 2007/08/01-2008/07/31

The acupuncture has been widely used to treat various diseases. The mechanism involved in the therapeutic effect elicited by the acupuncture maybe the activation of nerve activities influencing visceral functions via somato-visceral reflexes. Many acupoints (i.e. UB31, UB32, UB33, UB34, CV3, CV4, SP 6, KI3, and Uterus) with therapeutic efficacy for pelvic floor or lower urinary tract dysfunction via the lumbar-sacral spinal afferent inputs have been reported. However, the intracellular signal pathways involved in the effectiveness of acupuncture is still unclear. Recent studies in our laboratory found that the urethral reflex potentiation (URP), which was elicited by repetitive electroacupuncture (Ea) stimulation at abdominal muscle below the Uterus acupoint is essential for urine continence. In the present study we designed to apply 1 Hz Ea at Uterus acupoint for 30 min to establish a URP (long term potentiation-like reflex in the external urethral sphincter electromyogram activity) in anesthetized rats. To evaluate whether glutamate involves in Ea-elicited URP, intrathecal glutamergic agonists/ antagonists are administered during Ea test stimulation (TS, 1/30 Hz) / repetitive stimulation (RS, 1 Hz). In addition, the role of nitric oxide (NO) related in the Ea-elicited URP is also determined in the study. For this assay, spinal nNOS protein levels are measured 1 hour after TS/RS byWestern blot assay.

NO and the downstream intracellular messenger cGMP, which is activated by soluble guanylate cyclase (sGC), are believed to induce long-term changes in efficacy at glutamatergic synapses through activation of protein kinase G (PKG). The aim of 2nd year is to study the involvement of the NO/sGC/PKG pathway in a novel form of Ea-elicited glutamate-dependent URP. To determine the participation of nitrergic neurotransmission in the cyclophosphamide (CP)-elicited facilitation on the distension-induced URP is another specific aim of this study at the 3th year. We infer that the increased production of nitric oxide in spinal levels appears to be involved in the hypergesia and/or hypereflexia induced by CP. To decrease nitrergic neurotransmission is proposed to prevent the side effect that CP administration to patients causes hemorrhagic cystitis.

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主要研究領域

生醫信號處理、醫學資訊系統及醫學健康教育數位學習

Major Research Areas

biomedical signal processing ,medical information system, e-learning in medical and health education

研究計畫

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

Research Projects

The development of the homecare health detector - function indicator AST (GOT) /ALT(GPT) monitoring system

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
補助單位： 學術領域全面提升計畫
計畫期間： 2006-2007

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。

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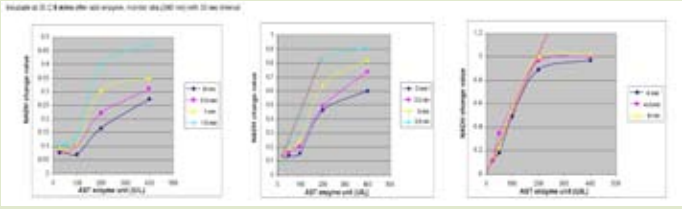
Project title: The development of the homecare health detector – function indicator AST (GOT) /ALT(GPT) monitoring system
Supported by: The project of advancement in academic fields
Project period: 2006-2007

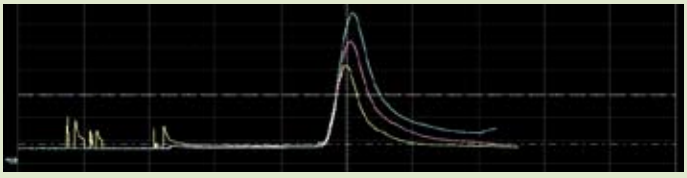
The liver cancer is the most common cancer in the world. Since liver cancer is deadly, patients suffering from cancer rarely last for more than one year. The World Health Organization estimated that in 1990 there were approximately 430,000 new cases around the world. About 430,000 died because of the 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.



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

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。

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國立臺灣大學生物技術中心資訊智財組 組長

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生物資訊暨生物統計核心實驗室

Bioinformatics and Biostatistics Core Lab.

主要研究領域

生物晶片、生物資訊、癌症生物、輻射生物

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。

Major Research Areas

Biochip, Bioinformatics, Cancer Biology, Radiation Biology

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.

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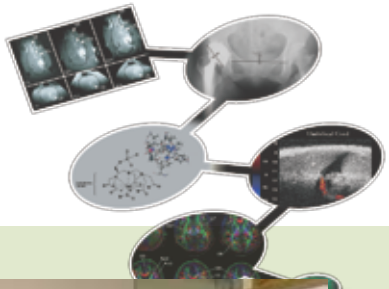

研究計畫

1. 研究人類肺部長期發炎反應改變腫瘤抑制基因的現象
2. 利用台灣地區常見癌症建立新的基因檢測平台
3. 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
4. 以基因體方式篩選台灣非吸菸女性肺癌病患染色體上變異及基因表現改變

Research Projects

1. To study how chronic inflammation modulate tumor progression in human lung
2. A new genomic platform for molecular characterization of endemic cancers in Taiwan
3. Bioinformatics and Biostatistics Core Facility
4. Genome-wide screening of genomic alteration and transcriptional modulation in non- smoking female lung cancer in Taiwan.

計畫名稱：以基因體方式篩選台灣非吸菸女性肺癌病患染色體上變異及基因表現改變
補助單位：行政院衛生署
計畫期間：2007/05-2010/04

肺癌是國人十大死因之一，也是國人最常罹患的癌症，在台灣的肺癌死亡率更高居世界之冠。吸菸經常被認為是導致肺癌的主要因素。但研究結果發現，只有大約7%的台灣女性肺癌病患有抽菸的病歷，明顯低於美國女性肺癌病患抽菸的比例。因此吸菸行為不能解釋台灣女性之高肺癌發生率，也因此台灣非吸菸女性肺癌之病因仍需進一步探討。雖然有研究證實烹煮時產生的油煙會引起細胞內的COX-2的表現，進而引起肺癌;許多研究也發現EGFR基因突變的機率在台灣非吸菸女性肺癌偏高，但也只能解釋50%左右的台灣女性肺癌病例。由於癌症的形成是由許多分子機制共同參與，因此要了解台灣非吸菸女性肺癌的病因，需要對肺癌細胞內的基因進行大尺度的分析。目前已知癌症的發生和細胞內致癌基因(Oncogene)與腫瘤抑制基因(tumor suppressor gene)的表現量改變有密切相關，而基因的複製及缺失直接影響基因的表現。此外，染色體的重組除了引起染色體倍數不平衡，也可能導致基因重組而形成具有致癌特性的蛋白質。為了進一步了解台灣非吸菸女性肺癌的致病機制，我們希望藉由microarray能進行大規模基因體的優勢，對台灣非吸菸女性肺癌組織內的基因表現及基因倍數上的變異進行篩檢。利用array CGH 搜尋染色體倍數的變異，以及利用DNA microarray來解析基因表現的改變，並利用high-resolution tiling arrays近一步鑑定發生變異的染色體區域上特殊基因的改變及確定發生染色體轉移的位置。找到新的基因指標會用於分析新的女性肺癌病患，對指標的準確性作為近一步確認。藉由這些分析所提供的分子特徵及基因指標，用以發展更準確的診斷與預後方法，並尋找新的治療方法。

Project title: Genome-wide screening of genomic alterations and transcriptional modulation in non-smoking female lung cancer in Taiwan
Supported by: Department of Health, Executive Yuan
Project period: 2007/05-2010/04

Lung cancer is the leading cause of cancer mortality in most countries, including Taiwan. The rate of increase in the mortality of lung cancer in Taiwan is the highest in the world. Smoking is usually considered to be the major risk factor for lung cancer, since about 90% of lung cancer worldwide can be related to cigarette smoking. However, only 7% of female lung cancer patients in Taiwan have a history of cigarette smoking, extremely lower than the percentage of the female lung cancer patients in the United States. Smoking behavior cannot well explain the exceptional epidemiologic characteristics of the lung cancer women in Taiwan. Thus, the etiology of lung cancer for non-smoking females in Taiwan remains unknown. Numerous reports have shown that the patients with lung diseases history or exposure to cooking oil fumes which can induce the expression of COX-2 have high risk of tumorigenesis. Other reports have also observed that epidermal growth factor receptor (EGFR) gene mutations are frequently detected in lung cancer, especially in females and non-smoking patients. However, EGFR gene mutations are only observed in about 50% of the non-smoking lung cancer females, and thus the conclusion that a significant relationship between EGFR gene mutations and non-smoking female lung cancer patients cannot be made. Moreover, carcinogenesis appears to result from the aberrations of multiple molecular pathways, genomic- scale analyses will be essential to reveal the etiology of non-smoking female lung cancer. Cancer appears to result from the progressive accumulation of genetic aberrations and genomic rearrangements leading to fusion proteins with oncogenic properties and chromosome copy number imbalances. Microarray technology provides a powerful tool to conduct genome-wide analysis of chromosome copy number variations and gene expression profiling analysis. For better understanding of the molecular mechanisms of non-smoking female lung cancers in Taiwan, we will use aCGH to identify chromosome copy-number changes, DNA microarray to elucidate the differences of gene expression, and high-resolution tiling arrays to determine specific gene changes as well as translocation events in identified altered chromosome regions. New bio-markers identified from those analyses will be used to assay new patients for further validation. Therefore, more accurate detection methods at diagnosis and prognosis and new molecular targets for therapy of non-smoking female lung cancer patients in Taiwan can be developed based upon the molecular signatures generated from this study.

We have completed the SNP analysis of 6 specimens by Microarray GeneChip Mapping 500K chip. We found that DNA high amplification regions at the chromosome 5p in three samples. We further investigated the potential genes of these alteration regions. Genes encoding S-phase kinase-associated protein 2 (SKP2), Glial Cell Line-Derived Neurotrophic Factor (GDNF), Nuclear transcription factor kappaB (NF-kappaB) in chromosome 5p were found in previous lung cancer-related studies. Regarding the gene expression, we found that 140 genes were expressed differently between lung cancer tissue and normal tissues. By using the IPA analysis, we found that genes in high amplification regions of chromosome 5p are involved in many pathways including cancer, cellular growth and proliferation.

目前已利用whole-genome sampling analysis (WGSA)，完成6個檢體初步之GeneChip Mapping 500K分析，在染色體5p附近有三組樣本在相同區域有DNA高度複製的狀況，進一步研究這些區域發現SKP2, GDNF, NF-kappaB 基因與前人研究肺癌形成有關。並依GeneChip Human Genome U133 Plus 2.0基因表現之初步結果，發現140個於肺癌檢體與正常組織表現有顯著不同表現的基因。經IPA綜合分析GeneChip Mapping 500K與基因表現的結果，顯示染色體變異區域上的基因確實與癌症的形成有相關性。

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Associate Professor, Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University
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SOC VLSI-EDA Lab.

主要研究領域

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。

Major Research Areas

BIO/Optical Microlithography Image Processing, VLSI CAD, Microprocessor Design, RF Mix/Signal Circuit Design

研究計畫

1. 次微米下之高速電路及低耗電最佳化
2. 動態邏輯加法器設計及自動化
3. 次微米級干涉週期量測之診斷演算法

Research Projects

1. Deep-Sub-Micron High-speed Low Power Optimization
2. Domino Adder Design and Automa
3. Efficient and Accurate Optical Scatterometry Diagnosis of Grating Variation Based on Segmented Moment Matching and Singular Value Decomposition Method

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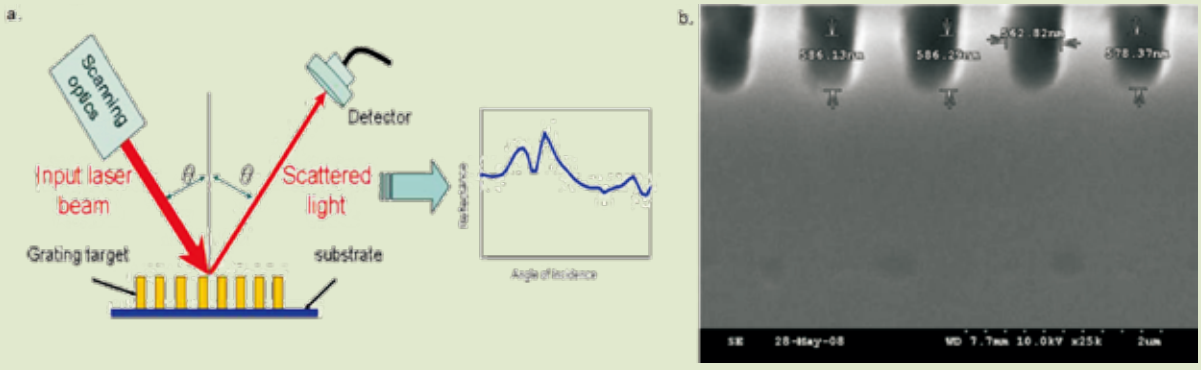
計畫名稱：基於分段式動差比對法以及奇異值分解之快速且準確的散射儀光柵變異診斷
補助單位：行政院國家科學委員會
計畫期間：2007/08/01-2010/07/31

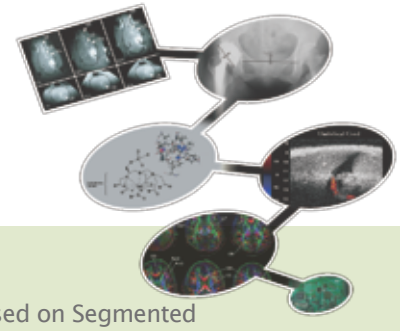
在奈米科技中，光柵 (Optical Grating) 的良率是相當重要的。為了要確保製作出的光柵良率，使用散射儀 (Optical Scatterometry) 去診斷實際光柵的形狀是一個有效率且實際的方法。大致來說，散射儀使用了不同的波長 (200nm ~ 700nm)去掃描光柵，並且收集在不同波長的反射波強度 (reflection spectrum)。如果我們事先能針對不同幾何形狀的光柵建立出對應的反射波資料庫，那透過比對此資料庫我們就能夠得知最有可能的光柵幾何形狀。

然而，因為製程不斷的縮小，物理的參數可能會產生很嚴重的偏差（圖1a為光學散射儀實驗的建置模型，圖1b為SEM的實際圖形）。因此，為了要涵蓋所有可能因製程偏差產生的光柵形狀，我們需要非常大量的模擬 (數量大於10^{12})。由此可知，建立一個可行的資料庫本身就是一見即為困難的事情，更不要說從資料庫裡面去比對出可能的光柵形狀了。為了要解決上述的問題，我們發展了數個有效的技術去建置一個壓縮的資料庫，更重要的是從這個資料庫搜尋的技術。這幾個演算法簡述如下：

首先，我們建置了分段式動差比對的方法去初步過濾出可能的光柵。在一開始，我們的資料庫會根據反射波強度的前幾個動差（平均、變異、偏態、峰態）階層式的(hierarchically)分類成數個子資料庫。一旦我們得到一個未知的反射波強度，我們就可以根據他們的動差去找到對應的子資料庫，並且在子資料庫中搜尋可能的光柵形狀（如圖2）。分段式動差主要有幾個好處，其一是動差很容易被分佈兩端的一些極值所影響，另一個是透過分段式的計算動差，我們可以處理只有量測到部分反射波強度的情形。另外，為了要確保我們可以有效率的壓縮資料庫以及找到最佳的結果，我們使用了奇異值分解（Singular Value Decomposition）加上最小平方法的技術。

結合了上述的幾種技術，我們提出的演算法可以相當有效的減少儲存的空間而且資料比對的時間也得到了大幅的提升。我們的實驗結果顯示在一個如此大的資料庫裡做搜尋，僅僅需要數秒的時間，並且我們較原始的資料庫有超過100倍的壓縮率。





Project title: Efficient and Accurate Optical Scatterometry Diagnosis of Grating Variation Based on Segmented Moment Matching and Singular Value Decomposition Method
Supported by: National Science Council
Project period: 2007/8/1-2010/7/31

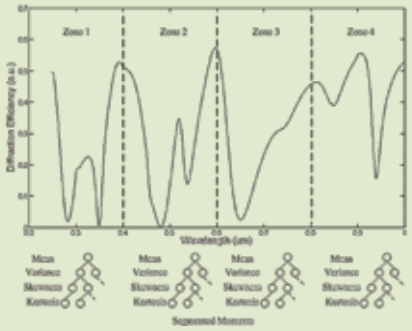
The quality of optical gratings is of great importance to the nanoimprint technology. To ensure the quality of the fabricated optical gratings, optical scatterometry (OS) is an efficient and effective mean to diagnose the actual fabricated geometry. Generally speaking, OS scans the reflection light spectrums of the gratings on varieties of light wavelengths range from 200nm to 700nm and more. If a comprehensive database of the reflection spectrum has been built, one can use the measured spectrum to search the matched pattern and finally find out the most possible fabricated shape.

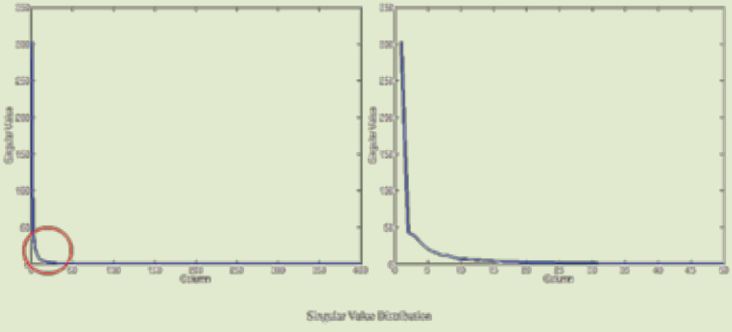
However, due to the everlasting shrinking process feature sizes, the values for the physical parameters of a grating may deviate significantly from the original design in our SEM chart as shown in fig. 1a (fig. 1b demonstrate the Optical Scatterometry Experimental Setup). Therefore, enormous amounts (more than 10^{12}) of simulations are required to cover all the possible parameters variation ranges. As a result, there are tremendous difficulties to even build the database, not to mention to efficient query the matched patterns. To resolve this issue, we develop several effective techniques not only to build compact databases and most importantly the efficient searching methods. The highlights of our novel algorithms are as follow:

First, a segmented statistical moment matching method has been developed to do a first filtering for possible matching patterns. In the beginning, all of the spectrum in the database will be classified and hierarchically sorted according to the values of the first few segmented moments such as mean, variance, skewness and kurtosis. The definition of the ith moment can be represented as:□□=1□ □□□□□=1. Therefore, once the spectrum of an unknown grating is measured, the calculated moments of the spectrum can be used as hierarchical indices to find the corresponding sub-database and the comparison for a similar spectrum can then be done. (see fig. 2) The novelty of our method is that since the standard definition of statistical moments often put more emphasis on the far end of the distributions, we first chop the spectrum into segments according to the ranges of the wavelengths (say 50nm). Another benefit of this method is that when only limited portions of the reflection spectrums are available, our method can still function correctly.

Second, to ensure the best fit (minimum error) of the result, the Singular Value Decomposition (SVD) technique has been employed. After applied SVD to the original database, A, the database can be decomposed into a product of 3 matrices, USVT, where U and V are orthonormalized basis and S contains singular values on the diagonal. We then reduce the database sizes according to the singular values as shown in fig. 3. In this way, with a measured spectrum, b, the search process can be fundamentally mapped to a least square fitting problem which can be mathematically expressed as follow: find the i-th basis which minimizes □□-□□□ 2.

Combing the two above mentioned methods, our proposed algorithm can effectively compact the storage and thus the overall comparison time can be significantly improved. Our experimental result shows that the search time for a large database case only needs less than a few seconds where more than 100X storage reductions has been achieved. The authors would like to thank ITRI for providing partial support to the work through the grant number 7301XS7400.





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Biomedical Optical Spectroscopy and Imaging Lab.

主要研究領域

生醫工程、生醫光電

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。

Major Research Areas

Biomedical Engineering, Biophotonics

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.

研究計畫

1. 白光多光譜影像系統與其生醫應用
2. 乳癌治療抗療性之整合研究 - 乳癌經放射治療、化學治療或合併治療後分子特徵之比較(子計畫二)

Research Projects

1. Hyperspectral imaging system using white light source for biomedical applications
2. Integrated approach to dissecting resistance of anti-cancer treatment in breast cancer - comparison of molecular signatures in breast cancer following chemo- and/or radiotherapies (subproject 2)

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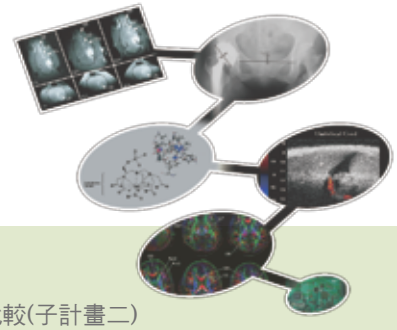
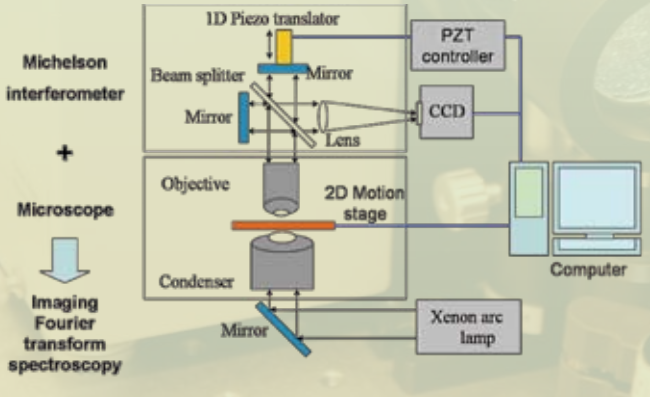


計畫名稱：乳癌治療抗療性之整合研究－乳癌經放射治療、化學治療或合併治療後分子特徵之比較(子計畫二)
補助單位：行政院國家科學委員會
計畫期間：2007/08/01-2010/07/31

本研究的目標是發展一個新的用於DNA微陣列晶片的檢測平台，其特點是使用單一光源與單一感測元件，達到在單一微陣列上同時檢測四種不同的樣本。主要的研究方法包含使用金屬奈米粒子作為光學偵測的信號源，以及建構一個結合干涉原理的超光譜暗視野顯微影像系統作為晶片掃瞄器。此一新的檢測平台主要的好處是可以改進使用螢光標記所造成的信號不穩定，以及資料量化之準確度易受背景螢光與雜質影響的缺點。我們將使用具有不同散射光譜的金屬奈米粒子來標記從不同樣本得到的cDNA分子，然後將已標記的多種樣本的cDNA混合後一起與微陣列晶片上的DNA探針進行核酸雜合反應。同時我們將開發數值方法，從測量到的混合散射光譜解析出個別的光譜成分，以達成基因表現的定量分析。我們計畫先使用合成的DNA作為開發此檢測平台與驗證其效能的工具，然後與常用的螢光標記與掃描的結果相互比較。之後我們將使用此一新開發的平台分析不同治療條件下，乳癌細胞與植入腫瘤樣本的基因表現，並且與螢光的結果比較，以評估新檢測平台的效能與實用的可行性。

Project title: Integrated approach to dissecting resistance of anti-cancer treatment in breast cancer – comparison of molecular signatures in breast cancer following chemo- and/or radiotherapies (subproject 2)
Supported by: National Science Council
Project period: 2007/08/01-2010/07/31

The objective of this research project is to develop a novel detection platform for DNA microarrays. Specifically, we aim for developing a multiplexed assay in which four samples can be analyzed simultaneously on a single microarray with a single light source and a single detector. The proposed platform is based on optical detection using metal nanoparticles (MNPs) as the reporters and a novel interferometer-based hyperspectral darkfield microscope system as the microarray scanner. The major advantages of the proposed platform are to resolve the problems of instable fluorescence intensity and interference from background fluorescence and contaminates. The target molecules of the proposed detection platform, cDNA molecules, will be made from extracted mRNA and labeled with one type of MNPs with distinct scattering spectrum. After being labeled with MNPs, cDNP molecules from multiple samples will be mixed and hybridized with probes in a microarray. Computer algorithms will be developed to unmix the measured scattering spectra into individual components and to quantify the expression level of each gene from each of the samples in the mixture. We will validate the new detection platform by comparing with the conventional fluorescence-based detection on synthetic DNA samples. Afterwards, we will study gene expression profiles of cultured cancer cells and xenografted tumors from animal models and compare the results to those obtained with the fluorescence-based method.



Schematic diagram of the hyperspectral imaging system
超光譜影像系統的架構示意圖

林致廷 助理教授 ***Lin, Chih-Ting,*** Assistant Professor

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無線生醫晶片系統實驗室

Wireless Bio-Electronics-System Lab.

主要研究領域

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

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。

Major Research Areas

Bio-NEMS, Bio-Chip, Nano fabrication, Biomolecular Detection Technology

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.

研究計畫

1. 奈米場效生物分子感測元件
2. 細胞監測晶片研發
3. 奈米螺旋碳管能源擷取元件
4. 次微米生物分子塗步技術
5. 無線感測器網路平台技術開發
6. 智慧生活整合性科技

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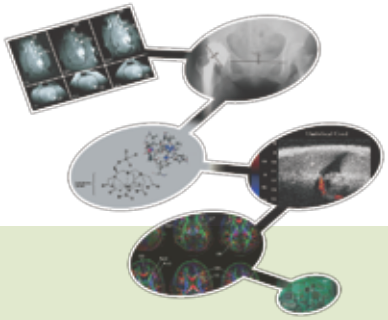


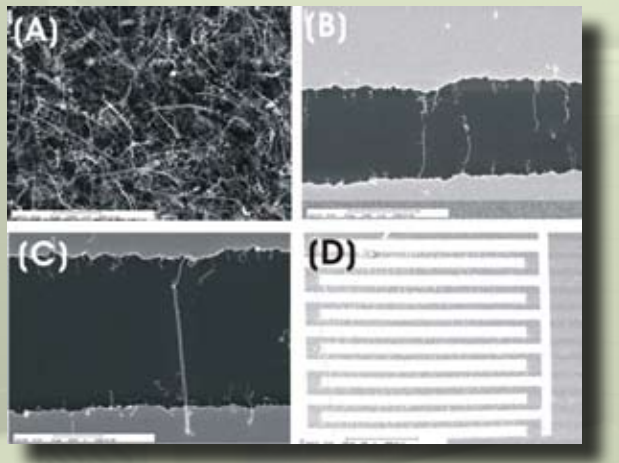
1. Nano FET Biomolecular Sensor
2. In-Vitro In-Situ Cell Monitoring Chip
3. Energy Harvesting Devices Based on Nano-Carbon-Coils
4. Submicron Protein Pattering Technology
5. Wireless Sensor Network Platform Technology
6. Smart Home Technology

計畫名稱：整合奈米螺旋碳管與微機電系統的能源擷取器
補助單位：行政院國家科學委員會
計畫期間：2007/08/01-2010/07/3

近年來因為奈米製程技術的蓬勃發展，使得相關奈米元件的研究亦受到相當的重視，有鑑於此，本計畫擬整合奈米螺旋碳管製備與微機電系統製程的技術，利用奈米螺旋碳管可所具有之力電偶合的特性，開發一整合奈米螺旋碳管與微機電系統的能源擷取器。具體的說明，本計畫擬開發之能源擷取元件，主要由一高感值薄膜與永久磁場構成，高感值薄膜內則以自我組裝之奈米螺旋碳管作為電感線圈，利用薄膜震動所造成通過線圈的磁通量的變化，使奈米螺旋碳管內部感生感應電流。在第一年的執行期間，針對奈米螺旋碳管自組裝的機制與製程進行研發，同時利用介電泳現象與元件表面型態現象成功的達成將奈米螺旋碳管自組裝於基材表面，並針對此一結果進行詳盡的驗證。預期此一成果將可以對次年進行奈米螺旋碳管薄膜力電耦合驗證之落實有極大的助益。

Project title: Energy harvesting devices based on nano-carbon-coil
Supported by: National Science Council
Project period: 2007/08/01-2010/07/3

Because of the advancement of nano-fabrication technology, the nano device has become an emergin research field. Among the various nano devices, the device based on the nano carbon coil is intriguing because of its outstanding conductivity and morphologies. Utilizing the electro-mechanical coupling effect of coil morphology in nano regimes, as the consequence, we propose to implement the nano-carbon-coil energy harvesting technique based on the nano-carbon-coil/micro-electro-mechanical-system integration. The proposed microsystem consists of a highly-inductive membrane and a permanent magnetic field. This membrane is configured by self-assembly nano-carbon-coil inside ferritin-PDMS composites. The nano-carbon-coil serves as the inductive coils. When the membrane oscillates due to ambient vibration, the magnetic flux inside the nano-carbon-coil fluctuates so that inductive current will be generated.



The experimental result of nano-carbon-coil self-assembly. It clearly demonstrates the nano-carbon-coil alignment can be achieved by dielectricphoresis with different frequency and electric-fields.

本圖顯示利用介電泳的方式達成奈米螺旋碳管的自組裝實驗，此一實驗完整的系統性驗證介電泳技術所必須之參數，可以獲得更有效的奈米螺旋碳管自組裝效率

賴飛羆 教授 *Lai, Fei-pei*, Professor

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Vice Superintendent, National Taiwan University Hospital
Professor, Department of Electrical Engineering/Department of Computer Science & Information Engineering, National Taiwan University

低功率超大型積體電路實驗室

Low Power VSLI Lab.

主要研究領域

低功率系統晶片設計、資訊安全、醫療資訊系統

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約三十餘名。本實驗室研究領域廣泛，實驗室創立初期以改良計算機結構為主，近年來改以低功率電路架構與多媒體晶片設計為主要目標，此外，目前本實驗室的成員也致力於參與臺大醫院醫療資訊系統之相關研究及開發，本實驗室的研究方向包含：

1. 低功率系統晶片設計與分析
2. 電腦與通訊網路安全機制研究
3. 醫療資訊系統

計畫合作方面，本實驗室除了每年與行政院國家科學委員會簽訂研究計畫之外，更與多家科技公司訂定產學合作計畫，使本實驗室理論與實作能真正結合。此外，為拓展本實驗室研究人員之視野，本實驗室特與德國Dortmund(多特蒙德)大學及加拿大Calgary(卡加立)大學訂立學術交流計畫，每年皆有研究生前往該大學進行學術訪問與研究心得交換，使本實驗室之研究得以多方面涉略與探討。

Major Research Areas

Low Power SOC Design, Security, Medical Information System

This lab was established in 1987 and Professor Feipei Lai, leads 14 Ph.D. students and 24 master students in this lab. The major research area in the lab includes *Low Power SOC Design, Security, and Medical Information System*. Our members participate in the research and development of the medical information system in Nation Taiwan University Hospital. Besides, our lab cooperates with numerous IT companies and other overseas universities including Dortmund University in Germany and Calgary University in Canada.

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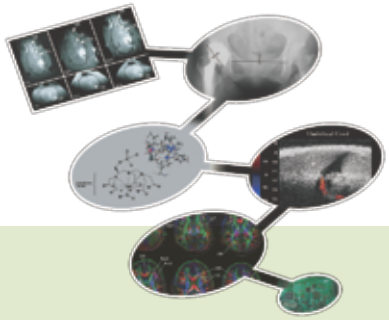


研究計畫

1. 低功率系統晶片設計的智慧型整體架構(國際合作計畫)(三年期計畫)
2. 數位權限管理系統(三年期計畫)

Research Projects

1. Low power intelligent communication architecture design for System-on-Chip
2. Sharing Control System Design for Peer-to-Peer File Sharing Applications

計畫名稱： 點對點檔案分享應用的分享控制系統設計
補助單位： 行政院國家科學委員會
計畫期間： 2006/08/01-2009/07/31

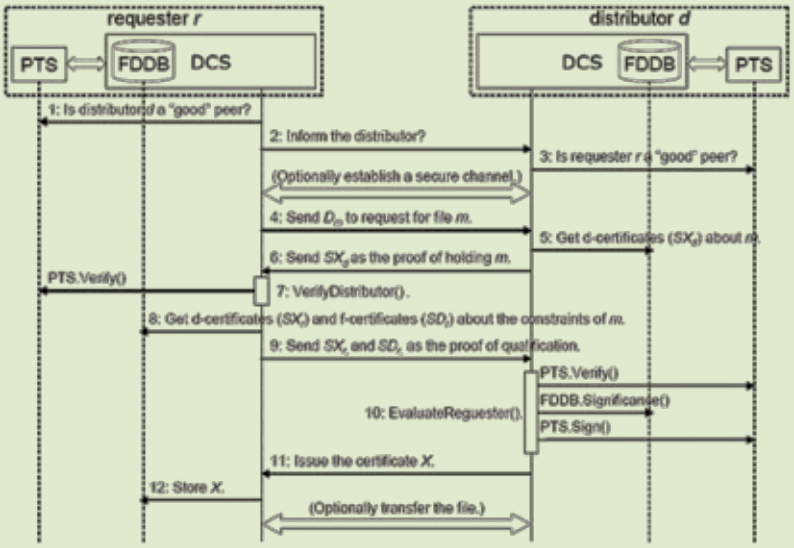
隨著網際網路(Internet)的快速發展，以及個人電腦及行動裝置的普及，點對點(peer-to-peer，簡稱為P2P)的應用也跟著廣為流行，P2P 架構的特色就是，讓peer 之間可以直接分享運算，儲存和頻寬等資源，而在不需要集中的伺服器的管理。利用P2P 架構來提服務的主要原因在於，這個架構提供了利用網際網路互連的設備，一個可以擴充和自我管理的平台，提供具有可取得性和穩定性的服務，由於其分散的本質，不會出現單點故障的問題，而且這個系統也可以防止惡意的干擾或破壞，如審查和阻斷服務攻擊等等。

檔案分享是目前最常見的P2P 應用，它讓使用者可以很容易地發佈，搜尋，和取得檔案，但是如果使用者希望把某些檔案只分享給他認為符合特定條件限制的人，現有的系統中卻沒有這種機制，而且在學術上也較少有這方面的研究。本計畫的目的，在於設計一個分享控制的系統，利用peer 之間互相簽署交換的憑證為依據，來達到檢驗與評量使用者資格，以達到分享控制的目標。在本計畫中，我們會設計系統的架構，研發憑證交換的協定，與憑證評量的演算法，利用軟體模擬來對協定及演算法進行改良和調整，也會就憑證的管理，複合式限制的憑證的評量，防止惡意攻擊等方面進行研究探討，最後我們會以Java 程式語言實作這個系統。

Project title: Sharing Control System Design for Peer-to-Peer File Sharing Applications
Supported by: National Science Council
Project period: 2006/08/01-2009/07/31

With the growing scale of the Internet, and the emergence of powerful personal computers and mobile devices, peer-to-peer (P2P) applications are gaining popularity. In a P2P system, peers can directly share their computation power, storage space and communication bandwidth with one another without the help of centralized servers. P2P systems offer scalable and self-organized service networks, and provide services with good availability and stability. Due to the distributed nature, P2P systems do not suffer from single-point-of-failure, and tend to resist intentional interferences and malicious attacks, such as censorship or denial-of-service attacks.

The most widely-used P2P application is file sharing. P2P file sharing enables peers to easily publish, search, and get files from the network. However, there are no such mechanisms in current P2P file sharing applications for a peer who wishes to share a file with only a special group of qualified peers to distribute the file in a controlled manner, and there is little research about this topic. The goal of our project is to design a file sharing control system. In the system, certificates are signed by and circulated among peers as credentials of their qualification for files with sharing constraints. In the project, the architecture of the system, the certificate exchanged protocol, and the constraint evaluation algorithms will be designed. We will use simulation to evaluate the effectiveness of our design, and to tune our algorithms. More advanced problems, including certificate management, the evaluation of certificates with composite constraints, and the robustness of the system against attacks, will also be studied. Finally, the whole design will be implemented in the Java programming language.



The illustration of the sharing control protocol
分享控制協定示意圖

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國立臺灣大學系統生物與生物資訊學研究中心 主任
國立臺灣大學資訊工程學系 教授

Professor, Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University
Director, Center for Systems Biology and Bioinformatics, National Taiwan University
Professor, Department of Computer Science and Information Engineering, National Taiwan University

分子生醫資訊實驗室

Molecular Biomedical Informatics Lab.

主要研究領域

生物資訊學、資料檢索/機器學習

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

Major Research Areas

Bioinformatics, Machine Learning

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
2. iPDA — prediction of disorder regions in protein sequences
3. Proteminer and Protemot — prediction of protein functional sites based on local structural alignment
4. MEDOCK — emulation of protein-ligand docking
5. Prote2S — prediction of protein secondary structures based on the polypeptide sequence

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研究計畫

1. 計算生物學先導型研究計畫
2. 虛擬篩選與嶄新藥物設計之整合計算平台—(子計畫二)針對虛擬藥物篩選設計先進機器學習演算法

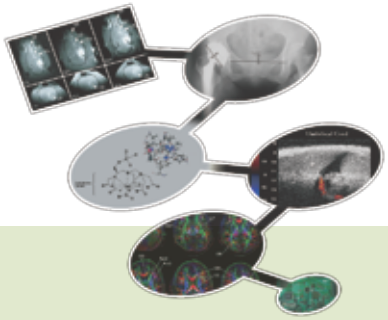
Research Projects

1. Pilot Research Program of Computational Biology
2. An integrated computational platform for virtual screening and de Novo drug design

計畫名稱：計算生物學先導型研究計畫
補助單位：行政院國家科學委員會
計畫期間：2006/12/01-2008/03/31

2003年完成的人類基因體解碼計畫為生物醫學與生物科技研究開啟了一個全新的世代。在這個新的世代，我們預期科學家將逐步能在生化與分子生物學層次解開各類疾病致病的原因與機制，同時科學家亦能夠運用後基因體時代的研究成果發展創新性的生物科技。儘管我們可以勾畫出極為樂觀的前景，然而上述的發展必須由基礎研究出發才得以實現。例如，針對細胞內調控網路之了解，將能幫助科學家發展以偵測調控路徑之異常表現為基礎的癌症診斷方法，並發展抑制或阻斷該異常調控路徑的醫療方法。當然，想要全面了解我們細胞及組織中的調控網路是一個極為困難的問題。經過上億年來的演化，高等生物體內的生物系統已然極端複雜。所幸，由於近年來醫學檢測與分析科技的進步，例如：基因序列定序法，微陣列技術，以及Chromatin-ImmunoPrecipitation DNA chip (ChIP-chip)等，科學家已能夠以十幾年前無法想像的速度，收集有關遺傳、基因、及調控網路之資料。然而，這些大量的資料如果沒有透過計算生物學的方法以及軟體的協助，是不可能被解讀的。因此，計算生物學將在現代生物醫學與生物科技發展上扮演一個關鍵性的角色。由於這個領域正處於爆炸性發展的關鍵時間點，因此也提供一個國內在科學研究與科技發展方面能夠以跳躍式的步伐躋身先進國家之列的千載難逢機會。同時我們亦認知到生物醫學及生物科技的發展在21 世紀中對一個國家的科技與經濟發展將有重大的影響，因此本計畫的執行將為國內未來這方面的發展建立堅實基礎。本計畫計包含總計畫及下列四個子計畫：

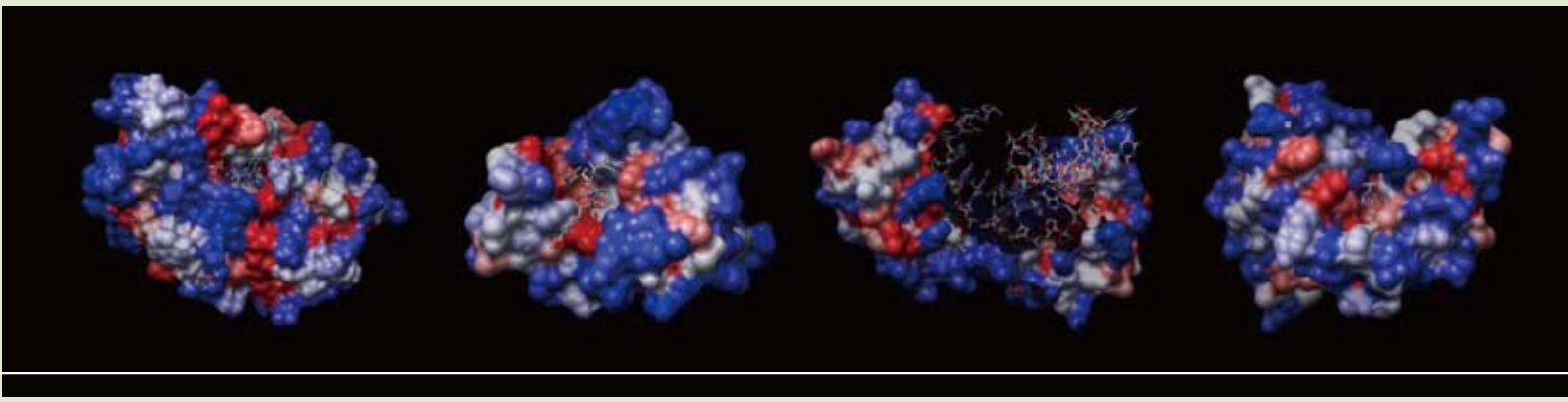
(1) 系統生物學及生物網路
(2) 計算結構生物學
(3) 整合性癌症生物學
(4) 基因體流行病學與統計基因體學



Project title: Pilot Research Program of Computational Biology
Supported by: National Science Council
Project period: 2006/12/01-2008/03/31

The completion of the human genome in 2003 marked the beginning of a new era of biomedical research. In this new era, it is anticipated that scientists will eventually be able to answer the causes and developments of many kinds of diseases at the molecular biology level. In addition, the research results in the post-genomic era will lead to the developments of revolutionary biotechnologies. Though extremely promising, the success of these revolutionary developments will not materialize without many years of fundamental research. For example, a good understanding of the pathway that leads to development of cancer cells may enable scientists to develop a novel diagnostic procedure to detect activation of the pathway and to invent a novel therapy that down-regulates or blocks the pathway. Surely, understanding the pathways in our cells and tissues is a difficult task. After billions of years of evolution, the biological systems within the body of higher animals have become extremely complicated. Fortunately, with recent advances in high-throughput technologies such as genomic sequencing, microarrays, and Chromatin-ImmunoPrecipitation DNA chip (ChIP-chip), scientists have been able to collect genetic, genomic, and pathway data at rates that are beyond imagination a decade ago. However, the huge amounts of data produced cannot be analyzed and understood without highly sophisticated computational methods and software. Therefore, computational biology has become an essential component in modern biomedicine. Clearly, computational biology aiming to facilitate development of modern biomedicine and biotechnology is a golden opportunity for a country to undertake in order to leap ahead in both scientific advances and economy growth. Accordingly, this proposed project will establish a strong foundation for Taiwan to exploit this golden opportunity. This integrated project consists of the main project and the following 4 sub-projects:

(1) Systems biology and biological networks
(2) Computational structural biology and structural bioinformatics
(3) Integrative cancer biology
(4) Genomic epidemiology and statistical genomics



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生物資訊實驗室
Bioinformatics Lab.

主要研究領域

生物資訊、計算分子生物學、基因演算法

本實驗室的研究主軸為生物資訊與台語文研究。在生物資訊方面，本實驗室將遺傳演算法與組合最佳化應用到生物問題上，解決各式各樣的問題。包含微陣列分析、蛋白質結構預測、蛋白質交互作用預測、藥物探勘與設計、虛擬藥物篩選等等。這些不同的研究主題，又能夠結合成為系統生物學，從更宏觀的系統角度來看生物問題，並將研發成果，轉譯到臨床醫學與藥物開發設計上。在台語文研究方面，本實驗室致力於台語文的計算語言學研究，包含台語文的輸入（光學文字辨識）與輸出（台語文語音合成）。未來希望能加入其他的元件，讓台語文能夠和電腦密切結合，協助母語教育與文獻研究。

Major Research Areas

Bioinformatics, Computational Molecular Biology, GA- Based Computing Technologies

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.

研究計畫

中心顆粒體之蛋白質交互作用網路--(子計畫一)以比較基因體學探討中心顆粒體之蛋白質交互作用網絡

Research Projects

POINT to the Comparative Interactome of the Midbody

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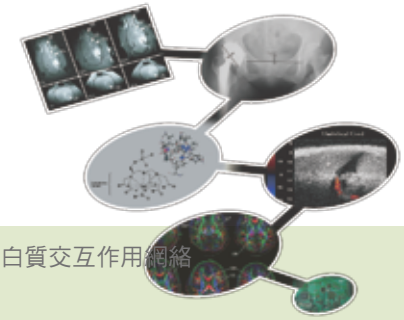
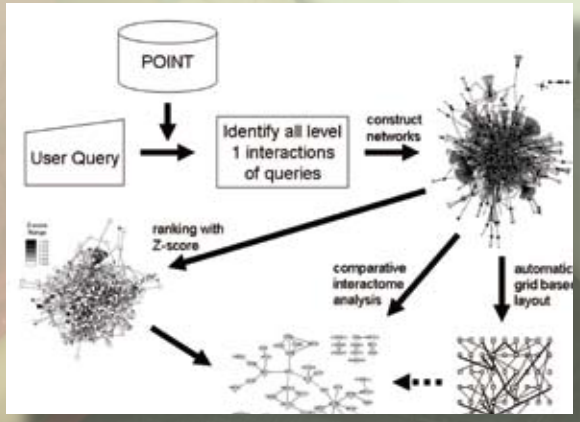


計畫名稱：中心顆粒體之蛋白質交互作用網路--(子計畫一)以比較基因體學探討中心顆粒體之蛋白質交互作用網絡
補助單位：行政院國家科學委員會
計畫期間：2006/08/01-2009/07/31

這個整合型計劃是建立在有關中心顆粒體近期的研究上，那就是約有50%的中心顆粒體蛋白質在三個不同的肺癌基因微陣列資料庫有顯著的差異。了解中心顆粒體如何形成、穩定及最後如何分解以讓複製的細胞分離，將可能對癌症研究領域有新的啟發。蛋白質交互作用需要適當的時間及空間上的結構，近來，有一研究團隊以蛋白質體學方式找到了158個中心顆粒體的組成蛋白質，並以確認這些蛋白質的保留功能。我們利用同樣的蛋白質體學方法產生了一個中心顆粒體在細胞質分裂時可能形成的蛋白質交互作用網路。這個網路包含190個中心顆粒體蛋白，而其中有98個可以在POINT (http://point.bioinformatics.tw/)這個我們近期才更新的蛋白質交互作用模擬網站中發現有和其他中心顆粒體蛋白交互作用，這樣的結果顯示這些中心顆粒體蛋白是藉由和彼此形成交互作用網路的方式來調控細胞質分裂的過程。因此我們假設這個由中心顆粒體蛋白所形成的網路若一旦被破壞可能導致人疾病的發生。如果這個網路的形成在肺癌的發生的扮演著角色，那麼我們要解決的下一個問題是我們該從這個網路中的何處著手又或者這其中有哪些分子可能參與肺癌發生的過程。為了找出更多在中心顆粒體的形成及功能上扮演關鍵位置的基因，我們嘗試使用各種方法去分析這個蛋白質網路的架構型態。其中一個方法是找出所謂的中心(hub)蛋白質，意即此蛋白質可與多個網絡蛋白質有交互作用，並以其為優先研究的標的。這些結果已經由其他子計畫驗證過，也說明了可能存在於中心顆粒體蛋白和肺癌之間的關聯性。

Project title: POINT to the Comparative Interactione of the Midbody
Supported by: National Science Council
Project period: 2006/08/01-2009/07/31

This integrated proposal is based on an interestingly observation, namely ~50% midbody proteins, which are available through proteomic screening and by literature review, are intersected with three different lung cancer microarray signature molecules. Resolving how midbody is formed, stabilized and finally resolved to produce two distinct cells may at least, in part, shed light on the way toward cancer biology field. Since a PPI requires proper spatial and/or temporal configurations, we use the midbody proteome inventories as an example to elucidate the potential PPI network occurring during cytokinesis at the midbody. Of the 190 midbody proteins examined, 98 of them can interact with other midbody proteins by using our recently updated protein-protein interaction database, POINT (http://point.bioinformatics.tw/). This analysis suggests that midbody proteins do not act independently at cytokinesis but form a network that modulates the cytokinesis process. This prompts us to hypothesize that could it be such organized networks are disrupted and subsequently lead to human disease. If this network is involved in lung carcinogenesis, the next question is where should we attack this network or which molecules might participate in the process of lung carcinogenesis. We have attempted to use various methods to analyze the topology of midbody network in an attempt to identify more critical nodes (genes) to the formation and functioning of midbody. One such category is the recognition of hub proteins, which are responsible for connecting numerous midbody proteins, immediately places these hub proteins as the prioritized targets. The results have been validated by other sub-projects, and provide possible link from midbody proteins to lung cancer.



Starting from the protein-protein interaction data in POINT, several strategies have been developed to identify important nodes in a biological networks.

利用 POINT 的蛋白質交互作用資料，發展數種策略以找出生物網路中的重要節點。

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國立臺灣大學資訊網路與多媒體研究所 教授

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數位典藏與自動推論實驗室

Digital Archives and Automated Reasoning Lab.

主要研究領域

自動推理、程式邏輯、數位圖書館與數位典藏

本實驗室由項潔教授主持，主要的研究領域為自動推論與數位典藏。自動推論的目的是發展可自動化的邏輯系統，以能利用計算機證明數學定理，乃至自動回答問題；數位典藏則是運用資訊科技將文化資產保存並使用。

自動推論方面，項教授在1985年於Journal of Artificial Intelligence發表關於Term rewriting systems的研究成果，在1993年被該期刊選為被引用最多的50篇論文之一。此外，在1986年發表 proof orderings，這個嶄新的 proof theory 已成為教科書的教材，並在2006年獲得 IEEE LICS 的 Test-of-time Award。

數位典藏方面，項教授自1996年投入國家數位典藏的推動，見證其從無到有的歷程。而本實驗室更在近年來在與臺大圖書館的合作及文建會的支持下，建置了臺灣歷史數位圖書館，提供全世界獨一無二的臺灣史全文資料庫。我們相信，隨著「量變」之後而來的應該是「質變」。換句話說，隨著如此大量且易於使用的全文資料，歷史研究的方法亦應隨之改變，而資訊科技應可在這個新的歷史研究方法論上扮演重要的角色。我們稱這個結合歷史研究與資訊科技的新學問為「歷史資訊學」，也是本實驗室以後研究的主要方向。

Major Research Areas

1. Foundation of Computer Science: term rewriting systems, automated deduction
2. Programming Languages: logic programming, logics of programming
3. Digital Libraries and Digital Archives

Before returning to Taiwan, Professor Hsiang's main research emphasis had been on automated deduction and programming logics, most notably in term rewriting systems. A paper that he wrote in 1985 on this subject was selected in 1993 by the Journal of Artificial Intelligence as one of the 50 most cited papers from that prestigious journal. Another one he wrote in 1986 and appeared in the IEEE LICS conference (with Leo Bachmair and Nachum Dershowitz) received the first LICS *Test-of-Time Award* in 2006.

Professor Hsiang started to work on digital libraries in 1996. He formed the first digital library/museum group of NTU, which included members from the Departments of Anthropology, Computer Science, Geography, History, Library Science, and the University Library. Their work served as a catalyst for the two major national projects on digitizing cultural heritage in Taiwan: the National Digital Archives Program of the NSC and the National Repository of Cultural Heritage Project of the Council for Cultural Affairs. He involved actively in both projects. He is also in charge of the digitization effort at NTU.

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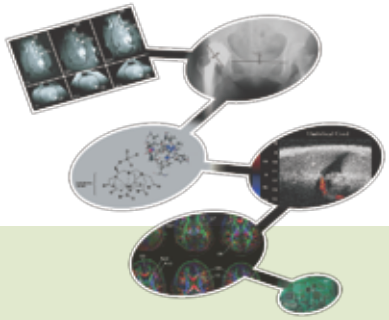

研究計畫

1. 國立臺灣大學深化臺灣研究核心典藏數位化計畫—國立臺灣大學臺灣研究核心典藏數位資源整合計畫
2. 臺灣大學深化臺灣研究核心典藏數位化計畫－深化臺灣核心文獻典藏數位化計畫
3. 臺灣大學數位典藏創新發展應用基礎計畫—總計畫:臺灣大學數位典藏推廣中心
4. 臺灣大學數位典藏創新發展應用基礎計畫－臺灣文獻數位典藏教學研究應用計畫：《淡新檔案》學習知識網
5. 臺灣歷史資訊學初探
6. 數位典藏國家型科技計畫 臺灣大學典藏數位化計畫－臺灣大學臺灣文獻文物典藏數位化計畫(子計畫一)
7. 數位典藏國家型科技計畫 應用服務分項計畫－數位典藏創意加值公開徵選計畫(子計畫一)
8. 數位典藏國家型科技計畫 應用服務分項計畫－(總計畫)
9. 適用於網際網路的邏輯推理架構之研究

Research Projects

1. National Taiwan University Archives Project for Resources Integration
2. National Taiwan University Digital Taiwan-Related Archives Project
3. National Taiwan University Digital Archives Application Based Project
4. National Taiwan University Digital Taiwan-Related Archives Application Project：
   Tan-Hsin-Tang-An Knowledge Net
5. A Preliminary Investigation of Hist informatics (Informatics of Historical Data)
6. National Taiwan University Digital Taiwan-Related Archives Project
7. Creative Applications of Digital Archives Initiative
8. National Digital Archives Program：Applications & Services Division
9. The Study of Path Inference Language, a language for integrating and reasoning about Web documents.

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數位相機與電腦視覺實驗室

Digital Camera and Computer Vision Lab.

主要研究領域

數位相機、電腦視覺、自動光學檢測、數位影像處理

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。

Major Research Areas

Digital Camera, Computer Vision, Automatic Optical Inspection, Digital Image Processing

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.

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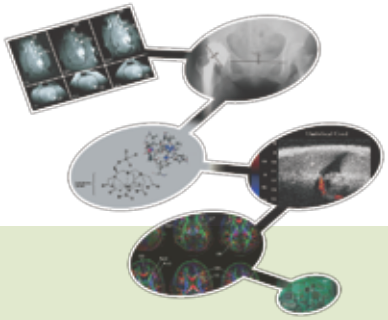


研究計畫

1. 數位相機之影像處理：色彩內插、色彩校正、色彩管理
2. 行動視訊高畫質顯示調適技術
3. 視訊會議使用的相機陣列
4. 用電腦視覺檢測與分類PLED面板瑕疵

Research Projects

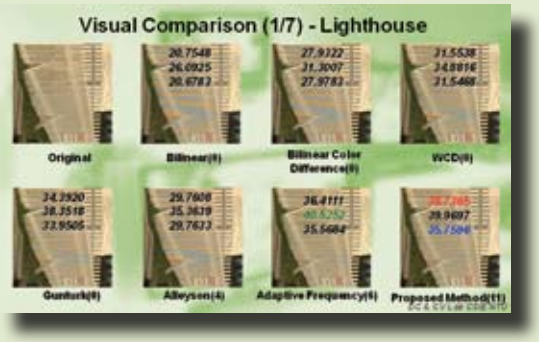
1. Digital Image Processing for Camera: Color Interpolation, Color Calibration, Color Management
2. High Quality Display Adaptation Technique for Mobile Video Device
3. Camera Array for Video Conferencing
4. Defect Inspection and Classification of PLED Panels with Computer Vision

計畫名稱：數位相機之影像處理: 色彩內插、色彩校正、色彩管理
補助單位：行政院國家科學委員會
計畫期間：2006/08/01-2009/07/31

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，進行數位相機色彩內插(Color Interpolation)、色彩校正(Color Calibration)、色彩管理(Color Management)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彩色濾光片(Color Filter Array)最佳色彩反應之各種色彩內插方法；第二年研究最適合的色彩校正演算法使色差(Color Difference)達到最小；第三年研究各種色彩管理方法，不管是原始物體色彩，數位相機擷取的影像，顯示在電腦監視器上及彩色印表機所列印出來的色彩都能忠實呈現而且不失真。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: Color Interpolation, Color Calibration, Color Management
Supported by: National Science Council
Project period: 2006/08/01-2009/07/31

This is a three-year project to use computer vision and digital image processing methods for color interpolation, color calibration, and color management of digital cameras. We will study the best camera, light source, environment, scene, and color interaction. In the first year, we will develop various color interpolation methods for different color filter arrays to achieve optimum color response. In the second year, we will research the best color calibration algorithm to minimize the color difference. In the third year, we will research various color management methods to develop programs and algorithms so that digital camera, color printer, and computer monitors will generate vivid and consistent color with high fidelity. 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.



Color interpolation: Color-difference domain, Weighted interpolation, No division & comparison operation, Operation: +, -, *, shift, clip, look-up table, Regular computation, Fixed-point implementation, 2 iterative loops for real-time embedded hardware implementation.

色彩內插: 考慮色差領域, 權重內插, 不需要除法或比較, 只要加, 減, 乘, 位移, 剪除, 查表, 規則運算, 不需要浮點運算, 兩次反覆迴圈, 適合即時內嵌式硬體實現。

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演算法與計算生物學實驗室

Algorithms and Computational Biology Lab.

主要研究領域

計算生物學及生物資訊學、演算法、套裝軟體

演算法與計算生物學實驗室創立於2002年8月。我們對於組合演算法的設計與分析很感興趣，尤其是關於解決計算分子生物學領域及網路應用上所產生的計算問題。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。

Major Research Areas

Computational Biology and Bioinformatics, Algorithms, Software Tools

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.

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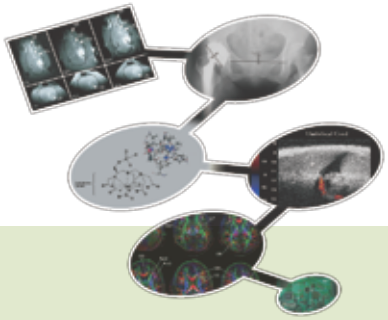


研究計畫

1. 單一核苷酸多型性資訊運用的演算法設計
2. 數列分析演算法及其在基因組序列分析上的應用

Research Projects

1. Efficient Algorithms for Utilizing SNP information
2. Constrained Heaviest Segments in a Number Sequence and Their Applications in Genomic Sequence Analysis

計畫名稱：單一核苷酸多型資訊運用的演算法設計
補助單位：行政院國家科學委員會
計畫期間：2005/08/01-2008/07/31

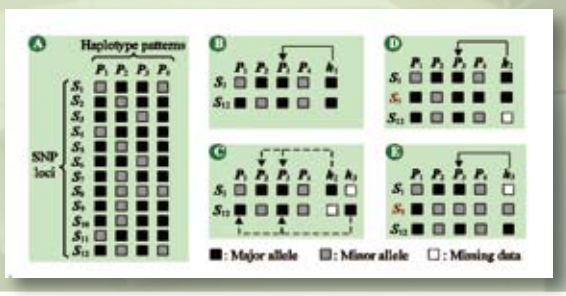
本計畫我們將致力於設計並實作一系列演算法，使得SNP和單套型的資訊運用在關連性研究與連索性分析上，能發揮出最大效益。第一年我們專注於研發從基因型資料推斷單套型資料之相關演算法。第二年我們致力於設計與標籤SNP選擇相關之演算法，以解決目前各種定序實驗上會遭遇的問題。第三年我們研究如何使用基因型和單套型資料，設計出切割單套型區段與標籤SNP選擇之演算法。

本計畫產出一系列與SNP和單套型相關之演算法和軟體。我們以各種數學模型分析所設計的演算法，而且每個提出的演算法都實作出軟體。我們將收集各種模擬資料與實際生物資料，針對每個軟體規劃實驗並加以佐證。我們相信本計畫所提出的方法與開發的軟體，不僅可以提升SNP和單套型資訊在關連性研究與連鎖性分析上之效益，更可以提出一些創新的思維與想法，以解決相關難題。

Project title: Efficient Algorithms for Utilizing SNP information
Supported by: National Science Council
Project period: 2005/08/01-2008/07/31

In this project, we aim to design and implement algorithms which can improve the power of using SNPs in association studies and linkage analysis. In the first year, we focus on the design and implementation of algorithms for inferring haplotypes data from genotype data. In the second year, we emphasize on solving the problems of tag SNPs selection with poor genotyping quality or genotyping errors. In the third year, we stress on the design and implementation of algorithms for haplotype block partition and tag SNPs selection directly using genotype or haplotype data.

We use different mathematical models to analyze each proposed algorithm. In addition, the proposed algorithms have been implemented and tested on a variety of simulated and biological data. The developed software along with the corresponding experimental results are available to the public. We believe that the results of our studies will not only improve the power of using SNPs in association studies and linkage analysis, but also provide more insights for solving related problems.



The influence of missing data when identifying haplotype samples.
失誤資料對單套體辨認的影響。

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Medical Image Processing Lab.

主要研究領域

醫學影像電腦輔助診斷、影像視訊處理、多媒體系統及通訊

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超音波診斷系統、彩色超音波診斷系統、超音波篩檢診斷系統、PC-based超音波診斷系統。合作研究單位有美國U-Systems超音波公司，法國INT/ARTEMIS雙聯博士計畫暨中法幽蘭計畫，並與韓國漢城大學醫院、日本獨協大學醫院、臺大醫院、台北榮總、中國醫大醫院、彰化基督教醫院醫師均有密切合作研究。

Major Research Areas

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

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 CAD, color Doppler US CAD, whole breast US screening system, color elastography CAD, and PC-based US CAD. The laboratory also collaborates with U-systems Inc., USA, and has a double Ph.D. program and the Taiwanese-French orchid project with INT/ARTMIS, Paris, France. We closely collaborate with physicians from Seoul National University Hospital, Dokkyo Medical University Hospital, National Taiwan University Hospital, Taipei Veterans General Hospital, China Medical University Hospital, and Changhua Christian Hospital.

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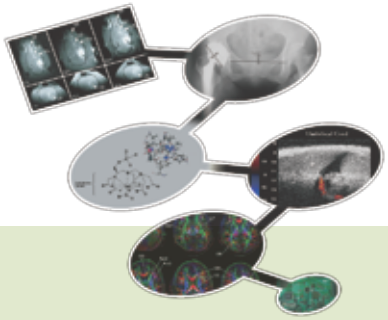


研究計畫

1. 個人電腦為基礎之乳房超音波及腫瘤切片診斷系統—總計畫
2. 個人電腦為基礎之乳房超音波及腫瘤切片診斷系統— 子計畫一：個人電腦為基礎之乳房超音波掃描診斷系統
3. 利用多重掃瞄及影像套合的大區域乳房超音波系統

Research Projects

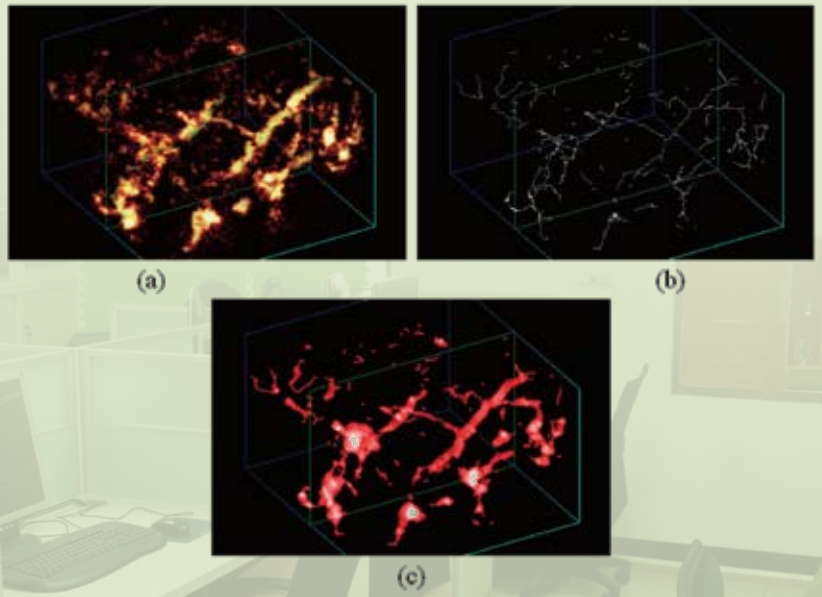
1. PC-based Breast Ultrasound and Biopsy Diagnosis System
2. PC-based Breast Ultrasound and Biopsy Diagnosis System: PC-based Breast Ultrasound Scanning and Diagnosis System
3. Large Area Breast Ultrasound Using Multi-Pass Scanning and Image Registration

計畫名稱： 3-D 彩色乳房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：2007/08/01-2010/07/31

血管新生作用在惡性腫瘤之生長、惡化與轉移過程中扮演著重要的角色。在最近幾年，和乳癌相關的血管新生作用已經非常廣泛地被研究並且對於血管新生行為模式、所影響的腫瘤發展結果和病人的預先診斷，乳癌所引發的血管新生被當成是一種去了解這些過程的標準範例。以往的相關研究，只是利用血管點數的多寡來診斷腫瘤。然而，對於乳癌而言，血管型態上和曲度上的特徵應能再提供更多的診斷資訊並且輔助醫生做更精密的診斷。本子計畫將研究一個全自動輔助診斷系統，這個系統是針對乳房腫瘤利用3-D Power 都卜勒超音波成像技術去取得血管超音波影像，最後再量化血管的型態及曲度特徵。為了從血管影像中取出型態和曲度特徵必須有一3-D的細化(Thinning)演算法來取得血管的骨幹(Skeleton)，然後再必須有一方法利用骨幹資訊建立出一個血管樹(Vessel tree)，如此即可由這些血管樹中取出型態上的特徵。而這些特徵將可利用來進行腫瘤診斷。3-D 彩色都卜勒超音波的資料可被解碼成兩種連續的影像，分別是紀錄腫瘤結構的灰階影像與保存血管資訊的血管影像。上述利用血管資訊的研究並沒有採用到B-mode灰階影像，因此如果此資訊可加入灰階診斷，因可再提高診斷及治療的準確度，例如可再考慮血管相對於腫瘤的位置關係，亦即新血管是否位於腫瘤內。為了量化此一特徵，腫瘤區域首先必須切割出來，以利分析血管與腫瘤位置之關係。我們將採用模糊理論演算法來切割腫瘤區域。完成腫瘤區域切割後，即可將原提出的血管特徵再區分成腫瘤內、外二種。

Project title: Computer-aided Diagnosis for 3-D Doppler Breast Ultrasound
Supported by: National Science Council
Project period: 2007/08/01-2010/07/31

Tumor angiogenesis is the process that correlates to tumor growth, invasion, and metastasis. Breast cancer angiogenesis has been the most widely studied and now serves as a paradigm for understanding the biology of angiogenesis and its effects on tumor outcome and the patient's prognosis. Most studies on characterization of tumor angiogenesis focus on pixel/voxel counts. However, in breast cancer, vascular morphology and tortuosity can provide more information that helps the physician diagnose more accurately. This project presents a computer-aided diagnostic (CAD) that can quantify vascular morphology and tortuosity using 3-D power Doppler ultrasound (US) on breast tumors. The method to extract morphological and tortuous information from angiography and to relate them to tumor diagnosis results is proposed. At first, a 3-D thinning algorithm helps narrow down the vessels into their skeletons and then the vascular trees could be produced from these skeletons. These measurements of vascular morphology will be used for the tumor diagnosis. A 3-D power Doppler ultrasound dataset could be decoded into two kinds of sequential images, grey and vessel images. The above study based on the vessel images does not use the information of grey images. Hence, if the grey images could be used in the system, the diagnosis accuracy might be improved. For example, the position relation of vessels to the tumor could be a good feature. For obtaining the feature, the grey images are applied by a fuzzy unit, a defuzzier unit, and connected component labeling techniques to determine the tumor region. Then, the vessels could be classified into inside or outside the tumor.



3-D Doppler ultrasound case (a) Original data. (b) The thinning result. (c) Three-dimensional reconstruction via the obtained vascular trees.

3-D彩色都卜勒超音波。(a)為原彩色超音波資料, (b) 細線化結果, (c) 利用血管樹重建出的3-D影像。

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演算法實驗室

Algorithmic Research Lab.

主要研究領域

演算法、圖論、生物資訊

演算法實驗室於2005年成立，目前我們有七位博士班學生與十八位碩士班學生。本實驗室的研究專注於基礎演算法的設計、分析以及應用。

Major Research Areas

Algorithms, Bioinformatics

The Lab of Algorithmic Research was established in 2005. We currently have seven Ph.D. students and 18 master students. Our research focus on fundamental algorithms and their applications.

研究計畫

平面圖之「簡潔編碼」與「簡潔呈現」演算法

Research Projects

algorithms for succinct encodings and compact drawings of planar graphs

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計畫名稱： 平面圖之「簡潔編碼」與「簡潔呈現」演算法
補助單位： 行政院國家科學委員會
計畫期間： 2005/08/01-2008/07/31

「平面圖」是圖論演算法這個領域裡最重要的一種「圖形類別」。過去八年來，我們在平面圖的「簡潔編碼」與「簡潔呈現」兩個方向上面花了許多心力，也很幸運地累積了不少有趣的研究成果。

最早，我們運用平面圖很重要的一個工具：即是Lipton與Tarjan的「切割點集」獲得平面圖最佳長度的「壓縮演算法」，但是這種「壓縮碼」並不支援快速的資料查詢。後來為了探討如何「簡潔地」記錄平面圖並且支援快速的資料查詢，我們發展出一個演算法工具「條理伸張樹」。運用這個平面圖演算法的新工具，我們獲得了目前文獻當中，能夠支援快速資料查詢的最佳平面圖「簡潔編碼」演算法。只是上面這兩個方向的結果各有力有未逮之處，我們希望能夠在目前所申請的這個計畫當中，探討是否能夠結合以上兩個結果的優點。說得更準確，我們希望可以替平面圖設計出「資訊理論最佳長度」的「簡潔編碼法」，同時又希望這個編碼法可以在不解碼的情況下，就能夠支援常數時間的資料查詢，包括查詢任意兩個節點是否相鄰、某個節點有幾個鄰居，甚至希望可以進一步在常數時間內回答任兩個點之間的距離是否在一個預定的常數之內。

Project title: Algorithms for succinct encodings and compact representations of planar graphs
Supported by: National Science Council
Project period: 2005/08/01-2008/07/31

Planar graph is an important graph classes. In the past few years, we spend efforts in algorithms for succinct encodings and compact representations of planar graphs and have obtained several interesting results.

Two main techniques have been used. One is the vertex separator of Lipton and Tarjan. The other is an algorithmic tool we invented, called orderly spanning tree. Two techniques have different strength. The former one is good at achieving optimal encoding lengths, the latter one is efficient in supporting queries. In this project, we plan to make progress in integrating both techniques and obtain results have both types of advantages.

An illustration of orderly spanning tree, where the tree edges are drawn in thick edges

本圖為一個三角化平面圖的一棵條理伸張樹。

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系統生物學研究室

Systems Biology Lab.

主要研究領域

系統生物學、蛋白質體學、生物資訊

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，並希望進一步達到開發新藥的目地。主要的目標是使用系統生物學研究法來研究在RGD胜肽及aurovertin B誘導下乳癌細胞進行細胞凋亡的作用機制；利用系統生物學研究法來開發新的藥物。

本研究室目前也利用系統生物學於能源開發上。Rhodopseudomonas palustris（R. palustris）是一種紫色非硫光合細菌。能轉換二氧化碳成為體內所需能量。我們以系統生物學來研究R. palustris的代謝路徑，描述和了解複雜的R. palustris生物系統如何運作，並將之應用於生質能源技術平台之研發。

Major Research Areas

Systems Biology, Proteomics, Bioinformatics

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

The other topic in our lab is to apply systems biology for energy-savvy microbes. Rhodopseudomonas palustris (R. palustris) obtains the energy necessary for hydrogen production through photosynthesis driven by the “free” supply of sunlight. We elucidate the functional genome of R. palustris using systems biology approach; then apply the results to develop biomass energy technological platform.

研究計畫

1. Annexin A4在胃癌癌化的分子機制
2. 以生質能源應用為導向之光合菌 *Rhodopseudomonas palustris* 系統與計算生物學研究
3. 光合菌 *Rhodopseudomonas palustris* 功能性基因體研究
4. 前瞻計畫-新穎化合物於癌細胞之系統生物學研究

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Research Projects

1. Molecular Mechanism of Annexin A4 in Carcinogenesis of Gastric Cancer.
2. Systems and Computational Biology of *Rhodopseudomonas palustris* Aimed for Bioenergy Application.
3. Functional genomics of *Rhodopseudomonas palustris*.
4. Systems-biology study of a novel compound on cancer cells.

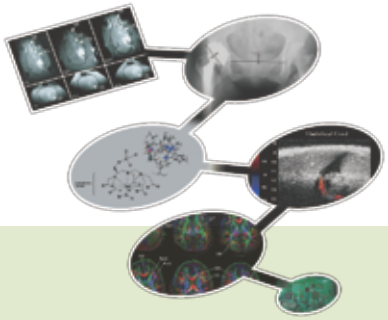
計畫名稱：新穎化合物於癌細胞之系統生物學研究
補助單位：臺灣大學前瞻與創新計畫
計畫期間：2006/09/01-2008/08/31

系統生物學是在生物學上一個新興的領域，它著重於以系統的觀點來了解生物系統的運作。由於高通量藥物合成、蛋白質體、微陣列及生物資訊技術的發展，使得系統生物學的研究愈發可行了。生物轉變的整體研究將能加快闡明生化路徑及疾病治療的速度。除此之外，系統生物學也著重於描述和了解複雜的生物系統如何運作以及發展預測人類疾病的模式。在本計畫中將會利用系統生物學的研究方法來探討藥物對癌細胞的作用模式。

雖然疾病生物學很複雜，而藥物開發則必需倚靠生物反應，但是"基因到藥物"的希望之路已經是一觸即發，即將成功。對於改善現行的癌症治療，如何使藥物能專一地作用在癌細胞上仍然是一個主要的挑戰。因為RGD motif與很多重要的生化反應機制息息相關，所以找出最有效含RGD胜肽的藥物將是非常重要的。

本計畫主要的目標是要整合化學、生物學和計算學，並使用系統生物學研究法來研究在RGD胜肽誘導下乳癌細胞進行細胞凋亡的作用機制；進一步地利用系統生物學研究法來開發新的藥物以治療癌症。

本整合型研究計畫有幾個特定的目標，如以下所述：
1. 以RGD胜肽為基礎，設計並合成有潛力的藥物；分析這些抗癌藥物的作用活性。
2. 整合蛋白質體和基因表現的資料找出治療乳癌的生物標誌及新的藥物標的分子。
3. 以已鑑定的蛋白質和已研究的細胞凋亡路徑為基礎，開發高通量細胞凋亡蛋白質陣列平台。
4. 發展生物網路的電腦模擬程式；重新建構和模擬RGD胜肽作用於乳癌細胞凋亡的網路。
5. 運用定量PCR、 RNAi和蛋白質陣列的生物實驗來驗證模擬出的生物網路和路徑。



Project title: Systems-biology study of a novel compound on cancer cells
Supported by: NTU Program for Frontier and Innovative Research
Project period: 2006/09/01-2008/08/31

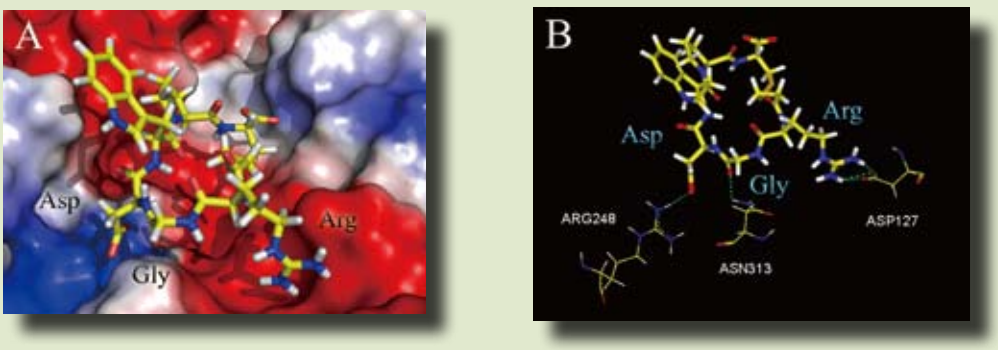
Systems biology is a new field in biology that focuses on an understanding of functional activity from a systems-wide perspective. Recently, with the advent of high-throughput drug synthesis, proteomics, microarray and bioinformatics technologies, the study of systems biology has become possible. The holistic study of biological transformations will enable more rapid advances in elucidating biochemical pathways and disease therapies.

The hope of the rapid translation of "genes to drugs" has foundered on the reality that disease biology is complex, and that drug development must be driven by insights into biological responses. Targeting drugs to tumor cells is a central challenge for improving existing cancer therapies. Since the RGD motif is involved in many important biochemistry mechanisms, it is of great interest to conduct the most effective RGD-containing peptide drugs. RGD-containing peptides have been demonstrated to strongly inhibit the adhesion, migration, invasion of tumor cells and tumor growth of human breast cancer cells.

The major objectives of this proposal are to integrate chemistry, biology and computation to investigate the molecular mechanism of apoptosis in RGD-peptide-induced MCF-7 breast cancer cells using systems-biology approach; furthermore, to discover novel drugs for cancer therapy.

Specific aims:

1. To design and synthesize potential drugs based on RGD peptides; to analyze the activity of anti-cancer drugs.
2. Identification of therapeutic biomarkers for the treatment of breast cancer by integrating proteomics and genomics expression profiles.
3. To develop high throughput protein array platforms based on the identified proteins and explore apoptosis pathways.
4. To development in silico modeling procedures for biological networks; then reconstruct and simulate the apoptosis network of RGD mimetic compounds acting on cancer cells.
5. To verify the biological network and pathways using biological experiments such as Q-PCR, RNAi and protein array.
6. To discover the molecular mechanism for novel compounds acting on cancer cells.



Binding mode of cRGD with integrin (PDB code: 1L5G). (A) cRGD is docked in the integrin active site. Hydrophobic (white), negativelycharged (red), and positively-charged (blue) surfaces. (B) The cRGD molecule is formed hydrogen bond with integrin by RGD residue.

本圖顯示cRGD和integrin結合後的三度空間圖。(A) cRGD結合到integrin的活化區。(B) cRGD分子和integrin藉由RGD殘基形成氫鍵。

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Assistant Professor, Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University
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Assistant Professor, Department of Pharmacy, National Taiwan University

生物資訊與化學資訊實驗室

Bioinformatics and Cheminformatics Lab.

主要研究領域

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

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. 以化合物高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。

Major Research Areas

Computational Chemistry and Computational Toxicology, Cheminformatics, Bioinformatics, and Medical Informatics.

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.

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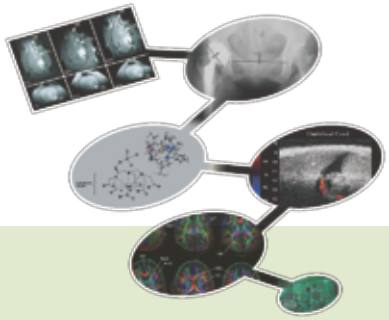


研究計畫

1. 三維結構構模式生物資料庫的快速檢索
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)

Research Projects

1. 3D conformational structure patterns for fast bioinformatics database searching
2. In silico aptamer platform for anti-angiogenesis on breast cancer (subproject 1 of Integrated approach to dissecting resistance of anti-cancer treatment in breast cancer)

計畫名稱：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)
補助單位：行政院國家科學委員會
計畫期間：2007/08/01-2008/07/31

在這個子計畫中，我們透過電腦平台來發展TW01系列(replace aptamers)的化合物，以期對於小分子在抗血管新生的藥物開發能有所貢獻。對於與receptor independent的QSAR分析，我們藉由一系列抑制劑的結構、比對和基團等資訊，藉由4D-QSAR的方法建立抑制酵素的相關結構活性定量模型。根據4D-QSAR對於BCM-TW這一系列激酶抑制劑中分析的結果，結構上的修正可用來做結構的最佳化。

QSAR模型是由TW01類似物對人類腫瘤細胞株MDA-MB-231(乳房)和PC-3(攝護腺)之IC50數值建構而來的基團模型。對於二個資料集中較佳的模型皆展現相關係數R2大於0.8與交叉驗證相關係數Q2大於0.7。從MDA-MB-231建構出之較佳模型的基團來看，IC50是與籠罩化合物的非極性或任意型態的描述子相關，即使是由PC-3所建構出的模型來看，亦有一個類似的基團之描述子比其他在同一模型中之描述子有較高的權重，此外其他出自PC-3模型之基團為負極性與氫鍵受體。

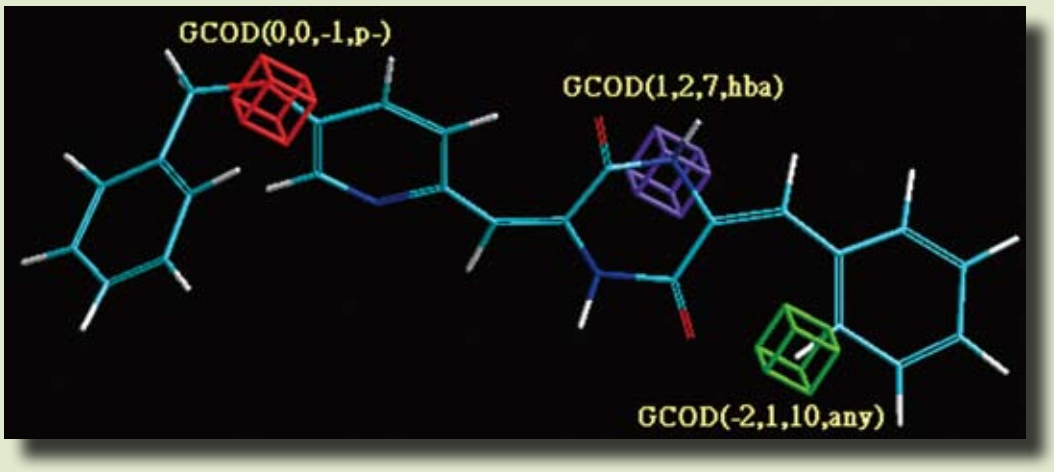
先前在激酶與ATP主要結合區域的基團研究中，結合模式高度地與散佈在蛋白質基酶ATP結合區域的疏水和芳香族基團有關，從4D-QSAR的基團模型與文獻推論，我們判斷ATP結合區域是TW01類似物最有可能的標的。

Project title: In silico platform for anti-angiogenesis screening
Supported by: National Science Council
Project period: 2007/08/01-2008/07/31

We developed an in silico platform for a series compounds as guides for anti-angiogenesis. We performed receptor independent 4D-QSAR analysis to construct quantitative models of enzyme inhibition as a function of the conformation, alignments, and putative binding pharmacophore of the series inhibitors from ligand structure and conformation profiles. The QSAR analysis result indicated possible structural modifications of the BCM-TW series class of protein kinase inhibitors with the goal of expanding the pool of TW01 series derived inhibitors of protein kinase.

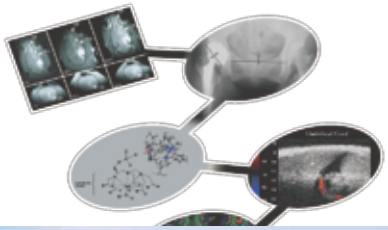
QSAR models were constructed and structure pharmacophore models with IC50 value of TW01 analogues against human tumor cell lines of MDA-MB-231 (breast) and PC-3 (prostate) were proposed. The preferred models for both two data sets contained correlation coefficients, R2, larger than 0.8 and cross-validation correlation coefficients, Q2, larger than 0.7. For MDA-MB-231, the pharmacophores of the preferred models indicated that the IC50 was related to the descriptors to specific special arrangement with the pharmacophore type non-polar. For PC-3 cell line assay, similar special arrangement descriptors with the similar pharmacophore type displayed the highest weight and much larger than the other descriptors in the same model. Moreover, the other pharmacophores in the model for PC-3 are either of polar negative or hydrogen-bonding acceptor type.

In the previous kinase pharamacophore studies on the main binding site with ATP, the binding mode highly depended on hydrophobic and aromatic pharmacophores around the ATP binding site of protein kinases. From the 4DQSAR pharmacophore model and the literature, we concluded that the ATP binding site was the most possible target for TW01 analogues.



Predicted Active Conformation for Compound BCM-TW-026 Using The Unique Models from Alignment. The grid cells from the model are the colored 1Å cubes. IPE type "any", "polar" or "H-bond accepter" was represented by the color of cube with green, red or violet respectively.

本圖顯示利用從演算法取得的單一模型預測化合物BCM-TW-026具有活性的構形，圖中的方格邊長皆為1Å，並分別以綠色、紅色及紫色分別表示”任何基團”、”具負極性”及”氫鍵的受體”等IPE的形式。

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