October, 2014第15期

醫工學會

http://www.bmes.org.tw/

中華民國生物醫學工程學會

Taiwanese Society of Biomedical Engineering E-Newsletter

更多醫工動態盡在醫工學會電子報，請即刻閱讀！
學會為了嘉惠醫工大家庭，100年4月回復電子報發行，預計每三個月出刊一期，敬請期待，對於本學會電子報，有任何意見，歡迎來電指教
(06) 2760665

目錄

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致各位親愛的會員：

時光飛逝轉眼間中華民國生物醫學工程學會已經第十六屆了，首先感謝各位會員的踴躍參與學會舉辦的系列活動，在所有理監事、各委員會和學會工作小組的努力之下，學會各項業務得以順利展開，由衷感恩所有付出心力和貢獻的夥伴。今年工作重點包括國家醫工證照持續推動、舉辦激勵生物醫學工程創意競賽、加強醫療器材產學合作、國際化提升台灣能見度。

弟承蒙各位會員及理監事、各委員會和學會工作小組的協助，接任理事長至今即將屆滿四年，在此由衷表示感激之意，未來將有新的團隊繼續為學會服務。這四年的首要任務除了醫學工程師證照立法外，國際化及推動醫療器材產業是近幾年的重點目標。第九屆 IFMBE 亞太生物醫學工程會議（APCMBE 2014）暨第一屆全球生物醫學工程會議(GCBME 2014)於 2014 年 10 月 9-12 日於台灣台南成功大學舉辦，GCBMBE 2014 是中華民國生物醫學工程學會成立 30 餘年來，首次將每年皆舉辦之年度醫工科技研討會改為以全英文國際研討會規格進行，旨為促進台灣醫工領域國際化，與國際接軌，此次與會的貴賓們對此次國際學術會議在成大舉行表示高度的肯定，也留下了深刻的印象。在高階醫療器材產業的推動上，學會近年也積極與台灣區醫療暨生技器材工業同業公會合作，交換代表出席對方理監事會，並整合分享各校資源，培育高階醫療器材專業人才，並努力推動台灣醫材產業開發創新醫材、提升醫療器材產業技術，希望台灣能在未來三、四十年急需的健康照護產業在世界上扮演重要角色，期許推動台灣成為醫療器材的大國，提升台灣經濟成長。

接任理事長至今即將屆滿四年，一個學會從成立到茁壯歷經三十幾年並不是件容易的事，因為有各位會員的支持愛護及批評指教，學會才可以一直傳承茁壯，在此由衷感謝各位會員於本人任內的愛護及指教，相信下一屆的理事長、理監事、各委員會和學會工作小組一定也能維持熱誠繼續推動會務，服務大家!

值此歲末迎接新的一年的到來之際

謹祝

新年快樂、平安喜樂、身體健康

弟　蘇芳慶 敬上

中華民國生物醫學工程學會理事長

中華民國 103 年 12 月 27 日

蘇芳慶 葉宗仁 王士豪 鞠躬

【成果榮譽】

本年度張冠諒教授紀念獎學金得獎名單如下：

博士級

蔡依蓉	國立成功大學	生物醫學工程學系

碩士級

吳宜真	義守大學	生物醫學工程學系
郭信宏	中原大學	生物醫學工程所

學士級

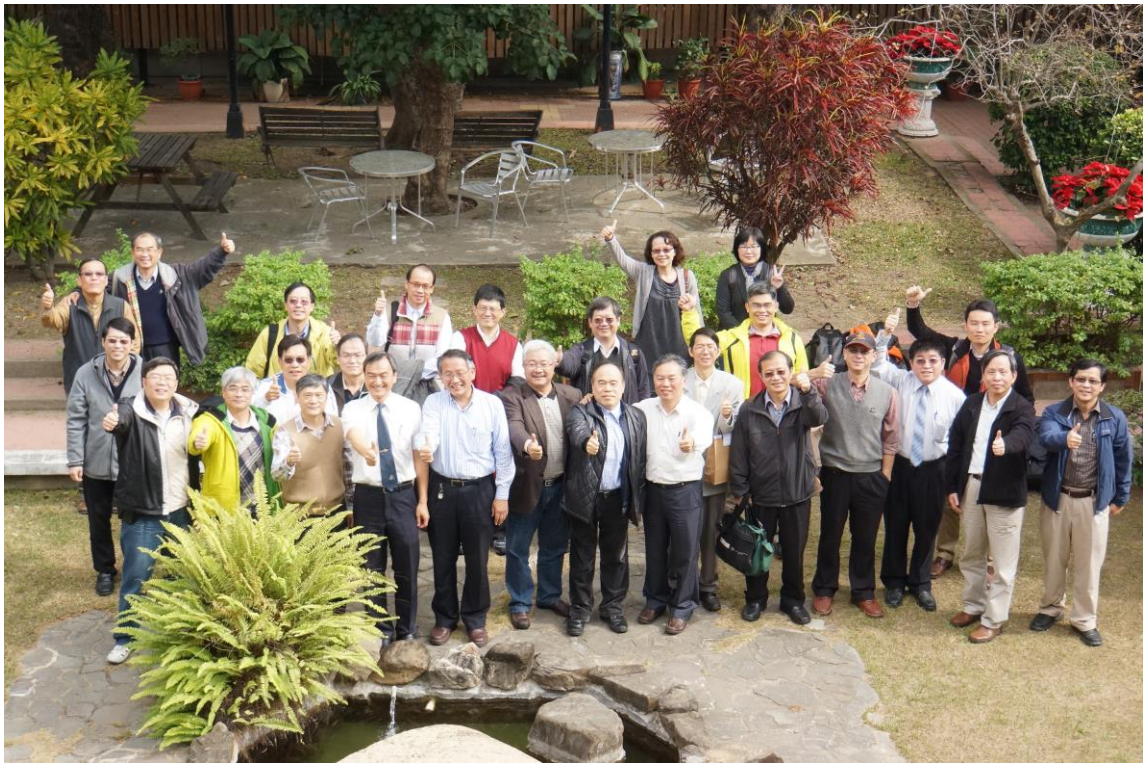
陳昕怡	國立成功大學	生物醫學工程學系
陳威旭	中原大學	生物醫學工程學系
林宜甄	義守大學	生物醫學工程學系

恭喜以上獲獎同學，相關詳細內容請見醫工學會網頁：
http://www.bmes.org.tw/notice_show.php?id=362

【第 17 屆理事、監事名單】

醫工學會於 103 年 12 月 13 日會員大會暨理監事改選，以及後續召開之理監事會議中選舉出第 17 屆理事、監事名單如下：（按姓名筆劃排序）

理 事 長：陳家進
副理事長：鄭誠功
常務理事：王兆麟、王家鍾、林峯輝、陳信泰、陳家進、蔡育秀、鄭誠功
理　　事：朱唯勤、朱湘麟、江青芬、姚俊旭、孫永年、張世明、張韶良、郭士民、陳天送、楊世偉、葉宗仁、鄒國鳳、錢嘉宏、謝明發
常務監事：蘇振隆
監　　事：江惠華、胡威志、張憲彰、黃執中、黃義侑、楊台鴻
秘 書 長：王士豪



103 年 12 月 28 日第 16 屆第 9 次暨第 17 屆第 1 次理事會議合影

GCBME 2014/ APCMBE 2014

第九屆亞太生物醫學工程會議(APCMBE 2014)
第一屆全球生物醫學工程會議(GCBME 2014)

第九屆亞太生物醫學工程會議（APCMBE 2014）暨第一屆全球生物醫學工程會議(GCBME 2014)於2014年10月9-12日於台灣台南成功大學舉辦，GCBMBE 2014是中華民國生物醫學工程學會成立30餘年來，首次將每年皆舉辦之年度醫工科技研討會改為以全英文國際研討會規格進行，旨為促進台灣醫工領域國際化，與國際接軌；Asian Pacific Conference on Medical and Biological Engineering是隸屬於國際生物醫學工程聯盟(International Federation for Medical and Biological Engineering, IFMBE)的國際會議，會議論文與Springer合作出版。此會議由國立成功大學與中華民國生物醫學工程學會及知名的國際生物醫學工程聯盟(International Federation for Medical and Biological Engineering, IFMBE) 所共同主辦。

第九屆亞太生物醫學工程會議，邀請美國梅約醫學中心安介南講座教授(Kai-Nan An)、IFMBE理事長克羅埃西亞薩格勒布大學Ratko Magjarevic教授、美國波士頓大學Herbert F. Voigt 教授、新加坡大學James CH Goh教授、美國南加州大學熊克平教授（K. Kirk Shung）、日本東京大學IchiroSakuma教授、美國明尼蘇達Arthur G. Erdman教授、美國賓州州立大學Cheng Dong 教授、日本神戶大學Kozaburo Hayashi教授等多位國際級大師與會及進行特別演講。

9日至12日在成大醫學院登場的會議，除了九屆亞太生物醫學工程會議(APCMBE)與全球生物醫學工程會議(GCBME2014)學術研討會外，也將召開國際醫學物理與醫學工程聯合會(IUPESM)理事會議、IFMBE理事會議，以及舉行亞太醫療器材創意競賽、南部生技醫療器材產業聚落發展會議、牙科植體與健康照護論壇、台灣醫材法規論壇、第九屆東亞地區生醫工程學生論壇等多項重要會議，相關的重要會議同時進行，盛況空前。

開幕式於9日下午3時盛大舉行，出席貴賓包括成大副校長蘇慧貞、國際生物醫學工程聯盟理事長Ratko Magjarevic教授、國際醫學物理與醫學工程聯合會主席Herbert F. Voigt 教授、南部科學工業園區陳俊偉局長、台灣醫療暨生技器材工業同業公會黃啟宗理事長等。大會主席成大前瞻醫療器材科技中心主任暨生物醫學工程學系特聘教授蘇芳慶指出，高齡社會到來，此次國際會議主軸是醫療器材創新、開創健康照護榮景，全球生物醫學工程領域產、官、學等專家千餘人齊聚一堂，不僅彼此交流，還能提升台灣國際知名度及生技醫學工程產學界的影響力。

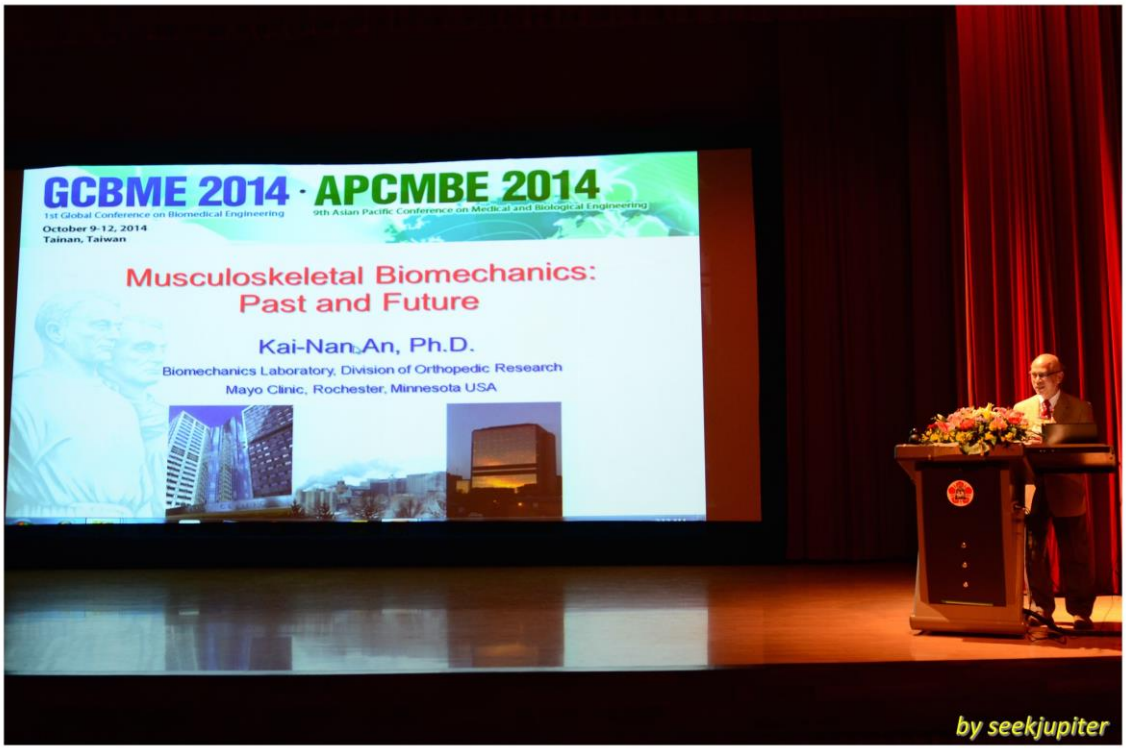
本會議廣邀世界級知名生物醫學工程研究領域之院士及國際生物醫學工程聯盟(IFMBE)領袖，透過舉辦國際頂尖會議，與國內外從事醫學工程相關領域之產、官、學、研之菁英的與會，提供與會人員與國外人士相互學術交流、相關業者及學生一同交流分享在醫學工程上最新與尖端的研究與成果，汲取國際生物醫學工程新知與動脈等機會並提升研究水準，促成國內在醫學工程這塊領域上不斷拓展既而與全球接軌，並希冀在不久將來能達到在學術上及產業上領先的地位。同時希望藉由此國際會議的舉行，提升我國及世界各國在生物科技與醫學工程相關領域之競爭力，同時提升台灣的國際知名度，促進學術外交，並且提升創新醫療器材產業，以達成行政院已啟動的「台灣生技起飛鑽石行動方案」的目標，加速學術研發成果商品化，轉譯研究為產業，以帶動產業發展及創造就業機會。

蘇慧貞副校長致詞表示，成大在工科領域表現亮麗，又有醫學院以及醫院，成大工科、醫科合作發展生物醫學工程已有20多年歷史，成果頗佳，這樣的發展與合作模式可供其他國家參考，成大產學合作的績效在世界的排名很高；台灣政府也在南部推動生物醫療器材產業聚落發展計畫，人才、技術、產業發展日益穩健，大型國際生物醫學工程會議在成大舉辦，希望能為彼此帶來合作的機會。國際生物醫學工程聯盟理事長Ratko Magjarevic教授指出，科技發達，帶動生物醫材的發展以及生物醫療技術的進步，讓人類更健康，會議提供各國人士交流機會、分享彼此的研究成果。

本次會議主要研討生物材料與組織工程、物力學與生物工程計算、生物醫學影像和信號、生物傳導器、醫療器械和儀器及生物醫學機器人和手術技術等生物工程相關領域。讓專家、學者、研究人員、學生等發表他們最近的研究成果並交換研究心得。

整體而言，本次的會議再次提升學者們對生醫工程領域研究的認識並了解其重要性。所有與會的貴賓們對此次國際學術會議在成大舉行表示高度的肯定，也留下了深刻的印象。主辦單位感謝所有贊助單位的協助，使得大會在軟硬體的製作、準備上更加完善，使整個會議之籌辦工作能更加順利進行，並圓滿的完成會議的舉辦。國內外與會的學者除了從會場上獲得新知外，也對台灣台南的文化有進一步的體驗與瞭解，是相當難得的經驗，最重要的是將台灣生醫工程和醫療器材經驗和研究成果讓國外學者了解，並提升至國際舞台。

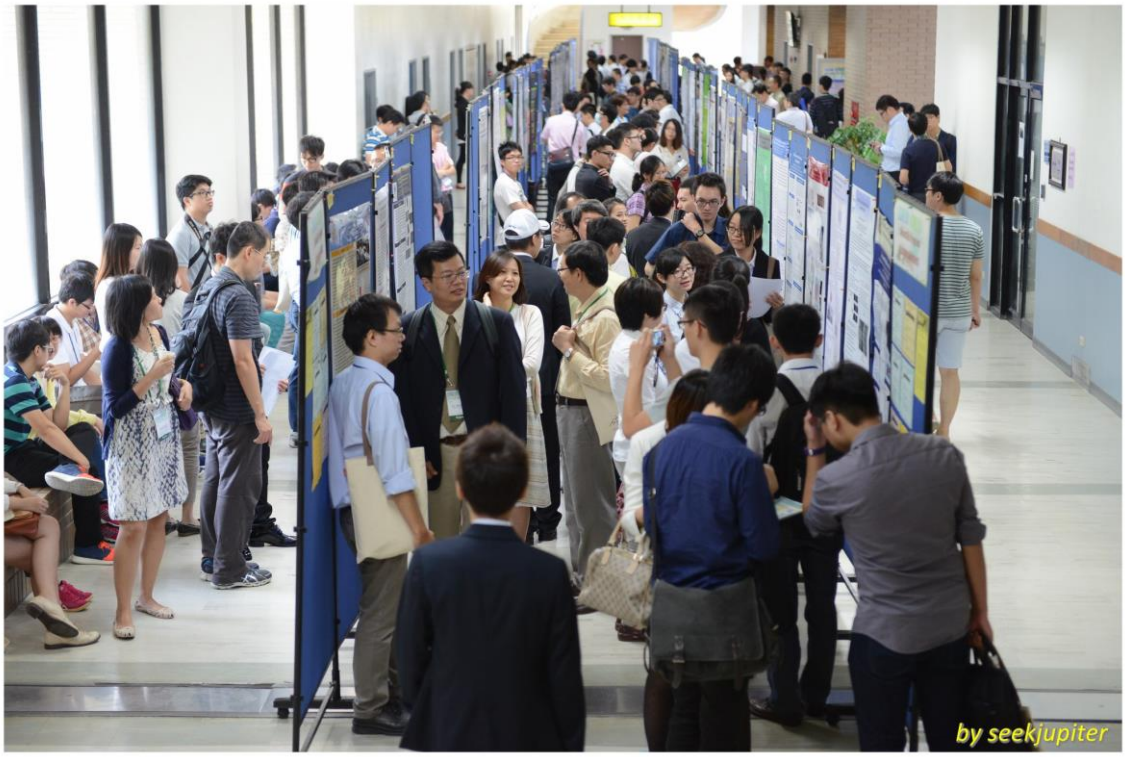
GCBME 2014/ APCMBE 2014 活動剪影



Opening Lecture: Prof. Kai-Nan An

研討會貴賓合影

貴賓報到處



學生海報競賽展示區

IFMBE& Springer 攤位

10/09 歡迎宴

（賴清德市長、Prof. Shankhar Krishnan、Prof. Ratko Magjarevic、蘇芳慶理事長）

南部生技醫療器材產業聚落計畫成果發表

9th East Asian Consortium on Ciomedical Engineering

Women in Biomedical Engineering

10/11 晚宴

Innovative Medical Devices Panel Discussion

工作會議

國立清華大學生物醫學工程研究所

成立經過

國立清華大學素有堅強的生物醫學工程研究群，分布在工學院、原科院、生科院及電資院相關系所，該研究群在奈米生物醫學領域、組織工程與再生醫學領域及智慧型生醫系統領域，早已有許多整合型研究計畫進行，並設有相關學程（如生物工程學程、生物產業技術學程及人因工程與安全管理學程）進行招生作業。

為進一步整合及推動相關領域之教學研究、提升本校研發質量，並且也為國家政策推動的新竹生醫園區培養研發人才，本校於民國99年向教育部提出申請，在工學院底下增設「生物醫學工程研究所」，並由化工系宋信文講座教授擔任籌備委員會召集人，實際籌劃各項事宜。100年9月30日，本所獲部核准通過，101年8月1日正式成立，並同時招收第一屆碩士班研究生10名。

本所目前共有8位教師（含專任4位、合聘3位、兼任1位），每年招收15名碩士生（不含外籍生及陸生），未來將繼續延攬國內外優秀師資，積極推動設立博士班。短期內將先與本校「奈米工程與微系統研究所」共同成立「生醫工程學程博士班」，104年8月開始招生，首屆名額為3至5名。

教育目標

本所碩士班教育目標有三：

1. 厚植生醫工程之專業知識
2. 養成跨領域整合實作能力
3. 培育生醫產業之創新人才

核心能力

經過修業兩年，我們希望我們的畢業生能養成以下四項核心能力：

1. 生醫工程領域之專業技能
2. 創新思考及獨立研發能力
3. 多元整合與團隊合作精神
4. 寬廣的國際觀及交流能力

課程設計

稟持上述之教育目標與核心能力，本所研究方向分為「生醫微奈米科技」及「生醫材料工程」兩大區塊，開設有下列專業課程及共同課程：

共同課程	生醫微奈米科技	生醫材料工程
✓ 書報討論	✓ 奈米生醫及應用(王子威)	✓ 細胞生物工程(裘正健)
✓ 碩士論文	✓ 高等微流體系統(李國賓)	✓ 人工器官與組織工程(宋信文)
✓ 解剖生理學(孫瑞昇)	✓ 生醫分析感測技術(萬德輝)	✓ 癌症生物學與治療總論(陳韻晶)
✓ 生命科學與工程(王子威)	✓ 先進生物顯影技術(林宗宏)	✓ 生醫材料（王子威）
✓ 臨床醫學工程實習(孫瑞昇)	✓ 生醫奈米材料的設計與合成(萬德輝)	✓ 無機材料與工程特論(萬德輝)
✓ 生物科技與智慧財產(待聘)	✓ 仿生奈米感測器(待聘)	✓ 高等生物醫學技術(陳韻晶)
✓ 生技醫療產業法規(待聘)	✓ 微觀能量傳遞學(待聘)	✓ 藥物控制與釋放(待聘)
	✓ 生醫微奈米機電(待聘)	✓ 醫用高分子特論(待聘)
	✓ 電子式生醫奈米科技之應用(待聘)	✓ 分解性生醫材料(待聘)
		✓ 生醫材料表面特性分析(待聘)

未來隨著師資擴充，兩大研究領域將更進一步開設其他專業課程，並與本校科法所及科管院合作，支援智慧財產、專利等法律方面課程。另，為因應招收國際生等全球化需求，及培養本國學生以英語溝通之能力，本所新進教師所有專業課程皆以英語授課，以達到5年內全所90%課程以英語授課為目的。

研究發展

本所目前8位教師相關資料及研究專長如下：

姓名	最高學歷	專長	實驗室
宋信文 講座教授兼所長	喬治亞理工學院博士	生醫材料 組織工程人工器官 人工血液 藥物制放 奈米生醫	生醫材料實驗室
李國賓 合聘特聘教授	加州大學洛杉磯分校博士	微機電系統(MEMS) 微感測器 微制動器 微流體生物晶片 微光學系統 奈米生物技術	微流體生醫晶片實驗室
裘正健 合聘教授	成功大學航太所博士	血管分子生物工程 力學生物學 生醫工程	國衛院細胞及系統醫學研究所實驗室
孫瑞昇 兼任教授	臺灣大學臨床醫學所博士	骨科及創傷外科	台大醫學新竹分院骨科實驗室
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在研究上，本所將繼續著重在發展「生醫奈微米科技」、「生醫材料工程」兩項重要領域：

1. 生醫奈微米科技：
   (1) 開發醫學診斷用之生醫與微流體晶片。
   (2) 建立生醫訊號/影像的偵測及診斷技術。
   (3) 進行生醫光電量測以及奈米生醫分子檢測與操控等創新研究。

2. 生醫材料工程：
   (1) 整合生醫材料、藥物標的與制放、基因與細胞研究等相關技術。
   (2) 開發在臨床組織培養與器官再生等實務應用。

本所正式成立2年以來，已主辦或合辦多項學術研討會，如「2013醫工年會」、「2014國際創新藥物制放研討會」、「兩岸生醫材料暨藥物制放研討會」等，以促進知識交流、推動研究發展。未來亦將建立合作實驗室，鼓勵所內教授與其他系所教授，共同指導研究生，並共同提出跨領域合作計畫，培養具備整合生醫技術上、中、下游全方位能力之人才為宗旨，並且藉由跨領域合作，提升研發能量與質量。除此之外，透過本校豐富的產學合作管道（如長清計畫等），本所之研究團隊已初步建立與產業界合作之研究平台。中長期規劃如下：

1. 成立「Special Interest Group」機制，聚集具有相同研究目標的教授共同合作，打造異業結合的平台空間，定期舉行workshop, 邀請產業界及教學型醫院加入。

2. 整合系上相似領域的關鍵技術與專利，並與工研院生醫所、國衛院、製劑中心、生物技術開發中心、遠東紡織研發中心生醫材料組或其他法人、業界合作，進行技轉。

3. 專利、技轉與產學合作計畫成果列入獎勵及升等項目。

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以上，如有任何疑問，歡迎隨時與學會秘書處聯繫。再次感謝您的支持！

敬祝 業安

中華民國生物醫學工程學會

秘書處 敬啟

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Review: Recent Development of Signal Processing Algorithms for SSVEP-based Brain Computer Interfaces

Quan Liu, Kun Chen, Qingsong Ai, Sheng Quan Xie

Steady-state visual evoked potential (SSVEP)-based brain computer interfaces (BCIs) have gained considerable research interest because of their higher signal-to-noise ratio and greater information transfer rate than those of other BCI techniques. The signal processing algorithm is of key importance to the performance of BCI systems, and therefore plays a significant role in practical applications. However, there is no comprehensive review of the signal processing algorithms used for SSVEP-based BCIs. This paper reviews relevant papers and analyzes recent developments in use of these algorithms. The aim is to find their limitations to provide a guideline for researchers in this field of SSVEP-based BCIs. Techniques employed for signal preprocessing, feature extraction, and feature classification are discussed. Algorithms that can be applied to nonlinear and non-stationary signal processing are increasingly employed rather than traditional Fourier-based transforms because they are more suitable for the characteristics of SSVEPs. Spatial filtering techniques for channel selection are better at eliminating nuisance signals than those that use a single channel signal for processing. In addition, other factors that affect the performance of the system are discussed.

Computerized Stimulation Parameter Adjustment of Deep Brain Stimulation Minimizing Side Effects and Power Consumption for Parkinson's Disease

Wei-Yi Chuang, Paul Chang-Po Chao, Kuu-Young Young

Deep brain stimulation (DBS) is broadly applied for neuropsychiatric diseases and thus determining its mechanism is of interest, especially in terms of the neural structure surrounding the DBS probe and the volume of tissue activated (VTA) during DBS. For re-operations for battery replacement, a major issue is reducing treatment power consumption without compromising clinical benefits. To avoid side effects and to minimize power consumption, optimized adjustment of the stimulation parameters is required. This study thus proposes a scheme for determining the optimal stimulation parameters. An electromagnetic finite element model for a patient-specific physiological brain model is first established using magnetic resonance imaging (MRI) data. Using finite element analysis (FEA), varied stimulation parameters are applied to the electromagnetic model for VTA estimation. Optimal electrode contact(s) are selected based on the estimated VTA to avoid side effects. Moreover, a nonlinear programming method for optimizing the stimulation voltage and the pulse width is applied to minimize power consumption in DBS. The effectiveness of the model parameters was verified using five Parkinson's disease patients. The results demonstrate that the estimates of the VTA are consistent with the observations within the desired region of the brain while avoiding side effects and reducing power consumption by 13% on average. The proposed method allows clinicians and researchers to efficiently select the optimal stimulation parameters. Moreover, it provides valuable information for closed-loop stimulation protocols in DBS.

Concept of the Diagnostic Tool for Balance Telerehabilitation of Subjects with Stroke

Imre Cikajlo

The number of virtual reality applications in rehabilitation and telerehabilitation medicine is increasing. Unfortunately, without telediagnostics, telerehabilitation requires frequent outpatient clinical testing. This study thus proposes a diagnostic tool for virtual-reality-supported balance training for estimating functional balance progress during telerehabilitation using objective parameters. Four weeks of physiotherapy with assessment before and after the therapy and a follow up 2 weeks after therapy were carried out with 10 sub-acute stroke subjects. Goal-based tasks for standing-frame-supported balance training were designed in a virtual environment. An accelerometer-based tilt sensor not mounted on the subjects was used. The telediagnostics apply the fast Fourier transform (FFT) to movement data and the task time and number of errors committed are analyzed. Additionally the functional progress was estimated with clinical tests (Berg Balance Scale, 10-m walk test, Timed Up & Go test) and correlations with objective data were examined. The area under the FFT curve demonstrated balance improvement and had a moderate correlation with clinical tests, considering that all parameters showed improvement for each individual patient. The proposed tool enables the remote evaluation of the effects of virtual-reality-supported balance training. The tool may decrease the number of outpatient visits and enable the continuation of the rehabilitation process at home. However, to confirm the clinical reliability and practical value of the proposed tool, a further study with a large stroke population and healthcare business models are needed.

A Characteristic Study on NIPAM Gel Dosimetry Using Optical-CT Scanner

Chun-Hsu Yao, Wang -Ting Hsu, Jia-Jung Lee, Shin-Ming Hsu, Patrick Yuk-lun Ma, Bor-Tsung Hsieh, Yuan-Jen Chang

This study investigated the dose characteristics of N-isopropylacrylamide (NIPAM) polymer gel dosimetry in intensity-modulated radiation therapy (IMRT). The NIPAM gel was composed of 5% gelatin, 5% NIPAM, 3% Bis, and 5 mM tetrakis (hydroxymethyl) phosphonium chloride (THPC). The gel was poured into a cylindrical acrylic phantom with a diameter of 10 cm, a height of 10, and a wall thickness of 3 mm. The gel phantom was irradiated with IMRT. The phantom energy was 6 MV and the dose rate was 250 MU. The NIPAM gel was scanned using an optical computed tomography (CT) scanning system. In terms 2of uniformity, the intra-dosimeter showed a consistent dose profile at different depths and a deviation of less than 1.8%. The scanning results showed a consistent dose distribution for each scanning experiment. The percentage isodose lines from the measured data agreed well with those from the treatment planning system (TPS) at 60% to 100% dose level region which is acceptable for clinical applications. Gamma index analysis was performed for representative gamma comparison between the TPS and the measurement results. The acceptance pass rate was calculated for various criteria. The pass rates were as high as 99.5% and 97.8% with 5%/5 mm and 4%/4 mm gamma acceptance criteria, respectively. The results indicate that a NIPAM polymer gel dosimeter can be used in conjunction with optical CT as a dose verification tool, especially for three-dimensional dose verification.

Dynamic Postural Adjustments in Stance in Response to Translational Perturbation in Presence of Visual and Somatosensory Disturbance

Yusuke Maeda, Toshiaki Tanaka, Yasuhiro Nakajima, Tomoya Miyasaka, Takashi Izumi, Norio Kato

Despite many reports on the role of the sensory system in postural control, only a few studies have reported the relationship between sensory disturbance and dynamic postural control. To investigate capabilities for dynamic postural adjustment, this study quantitatively evaluated the response to translational perturbation. Perturbation was experimentally induced in eight subjects (all male, 21.3 ± 1.4 years old) using a platform movable in four directions (forward, backward, right, and left). The response was measured in terms of the center of pressure (COP) using posturography, and electromyography of the trunk and lower extremities, and joint angle using video analysis. The effect of sensory disturbance was examined when wearing translucent goggles and when standing on a soft mat. A significant difference was found in the displacement of COP between the cases with and without sensory disturbance. With disturbance, the medio-lateral and anterior-posterior components of the displacement increased in the posterior and lateral translations, respectively. In addition, postural response against forward translation was not affected by sensory disturbance compared with backward and medio-lateral translation. The results of these analyses provide information useful for the development of balance rehabilitation using translational perturbation.

Microdrive with Two Independent Moveable Sets for Wide-Ranging, Multi-Site, Multi-Channel Brain Recordings

Pen-Li Lu, Song-Cun Lu, Ying-Zheng Zhuang, Chen-Tung Yen, Fu-Shan Jaw, Ju-Wei Hsu, Meng-Li Tsai

Simultaneous recording in wide-ranging brain areas requires a wide yet adjustable horizontal inter-electrode distance. Microdrives proposed by previous studies have limitations in this regard. This study proposes a microdrive that accommodates two individual drives with adjustable inter-electrode distance in the horizontal axis, which extends the maximum inter-electrode distance in the horizontal axis and increases usage flexibility. The size of the electrode holders was increased to extend the maximum horizontal inter-electrode distance. The electrode holders are aligned vertically to decrease the size of the microdrive. The stability of the structure was increased by integrating the electrode holders, screws, and a supporting rod into a triangular prism. This configuration is compact and stable. The horizontal inter-electrode distance can be adjusted from 0.8 to 10 mm (or even wider) depending on the user's requirements. The moveable microelectrode set is small and light, with a weight of only 2.8 g and a height of 25 mm. The performance of the device was verified using simultaneous recordings of multiple single-unit activities in the diencephalon and cerebellar cortex of a freely moving rat.

Pulse Rate Variability Estimation Method Based on Sliding Window Iterative DFT and Hilbert Transform

Yongxin Chou, Aihua Zhang, Ping Wang, Jason Gu

An approach for deriving pulse rate variability (PRV) from photoplethysmography (PPG) signals is proposed. By combining sliding window iterative discrete Fourier transform (DFT) with the Hilbert transform algorithm, this method effectively reduces the influence of noise and sampling frequency compared with those of traditional methods. First, the fundamental component of the PPG signal is computed with the sliding window iterative DFT algorithm. Then, it is processed by an integer coefficient low-pass filter and the Hilbert transform to produce an instantaneous pulse rate (IPR). Finally, PRV is extracted from IPR in the frequency domain. PRV is also derived from the PPG signal in the time domain for comparison with that derived using the proposed method. Furthermore, PRV obtained from PPG signals at various sampling frequencies and with various noise levels is investigated. The results show that the proposed method can accurately derive PRV from PPG signals, even if the PPG signal has a low sampling frequency (4 Hz) and high noise (e.g., SNR is about 3.0). The experimental results indicate that the proposed method can be used to estimate PRV when the subjects are in different states (rest, sleeping, or visual fatigue). Moreover, the proposed method is efficient and thus suitable for detecting PRV in real time. It has potential for PRV assessment in various medical fields, such as home health and clinical and hospital environments.

Proliferation Effects of 42-kHz Radio Frequency Energy on Human Foreskin Fibroblasts

Chun-Yi Chiu, Po -Hsiang Tsui, Chao-Ming Su, Shyh-Liang Lou

Radio frequency (RF), which can penetrate the dermis to induce cell responses, has been frequently used in the field of skin regeneration. This study examines the potential of using RF treatment for skin wound healing. Human fibroblasts were exposed to a 42-kHz RF at various intensities for 30 min. The cell cycle progression, cell viability, and c-fos and c-jun gene expressions were evaluated using flow cytometry, an MTT assay, and reverse-transcription polymerase chain reaction after individual exposures. The results show that the DNA synthesis, cell viability, and gene expressions were upregulated by low-level RF, especially at 350 and 450 A/m2 of electromagnetic field exposures. Therefore, RF may play a predominant role in inducing cell proliferation through cell cycle progression and c-fos and c-jun mRNA activation. Non-thermal RF may be the major cause of generating the cell response.

Computer-assisted Design of Patient-specific Sagittal Split Osteotomy Guide and Soft Tissue Retractor

Erol Cansiz, Yunus Ziya Arslan, Fatih Turan, Berkem Atalay

Sagittal split osteotomy (SSO) is a maxillofacial surgery procedure that is used to correct mandibular prognathism, retrusion, or asymmetry. During an SSO, the use of sharp rotary tools for the osteotomy can induce complications, especially during the osteotomy of the medial side of the mandibular ramus. In this study, to decrease SSO complications, a computer-assisted, patient-specific sagittal split osteotomy guide and soft tissue retractor is developed. Computed tomography (CT) images of a human cadaveric mandible were digitally converted into a three-dimensional (3D) model. Then, a case-specific 3D model of the proposed device was designed for the surface of a cadaveric mandible, with the osteotomy line and geometric dimensions of the mandible both taken into consideration. The created 3D model was used to manufacture the device using the metal laser sintering method. Finally, an SSO with the device was performed on the cadaveric mandible used to acquire the CT data. The proposed device ensures that the osteotomy planned in computer- aided preoperative preparations is applied correctly in the operation. Its use during an SSO is expected to shorten the operation duration and time needed for general anesthesia, resulting in less exposure time to bacteria. The shorter operation time is expected to reduce complications, the postoperative hospitalization period, and required corticosteroid amount for edema control.

Computer-assisted Fracture Reduction and Fixation Simulation for Pelvic Fractures

Pei-Yuan Lee, Jiing-Yih Lai, Shou-An Yu, Chung-Yi Huang, Yu-Sheng Hu, Chien-Lin Feng

Pelvic disruption is among the most complex injuries in orthopedic surgery because of the complex fracture patterns in the pelvic structure. Traditional preoperative planning using two-dimensional medical images usually encounters the problem of insufficient information for accurate assessment. In our previous work, a preoperative planning system that uses three-dimensional (3D) medical images and models was developed for the pre-surgical assessment, planning, and simulation of pelvic surgery. In this study, two additional functions, namely semi-automatic bone reduction and several types of fixation simulation are proposed to enhance the integrality of the proposed system for clinical applications. Ten clinical cases are presented for feasibility verification. For some of the cases, the surgeon carries out the simulation first, and then performs the surgery using procedures very similar to those in the simulation. The primary contribution of the proposed system is that the surgeon can go through the critical part of the surgery with the proposed 3D planning and simulation to fully understand the fracture pattern and make an appropriate surgical plan beforehand.

Cone Beam Computed Tomography for Adaptive Radiotherapy Treatment Planning

Kavitha Srinivasan, Mohammad Mohammadi, Justin Shepherd

Cone beam computed tomography (CBCT) images obtained from linac-based kV imagers are typically used for image-guided radiotherapy, in particular to perform three-dimensional image matching. CBCT image sets can also be used for adaptive radiotherapy where the treatment plan is modified on the basis of periodic imaging throughout the treatment course. CBCT images provide both anatomical information and Hounsfield unit (HU) values, which are required for dose calculations. This study evaluates treatment plans based on CBCT datasets calibrated using the Catphan 504 phantom to investigate the feasibility of using CBCT for adaptive replanning. The CBCT images were acquired from a Varian On-Board Imager system. Conventional planning CT (PCT) images obtained from a Philips Brilliance Big Bore CT scanner were used as reference images. The HU-density calibration curves of CBCT were obtained using a Catphan 504 phantom and a CIRS density phantom and compared with the clinical PCT calibration curve (obtained using the CIRS density phantom). Treatment plans created using the different calibration curves were compared. Identical targets were delineated on CBCT and PCT images on four different-sized phantoms and planar dose maps were generated. The dose-volume histograms of PCT- and CBCT-based plans were compared and evaluated by gamma analysis. To extend the study to a typical clinical situation, two prostate cases were included. The dose distribution comparison between PCT- and CBCT-based plans for patients yielded similar results to those obtained using phantoms. The study also analyzed the effect of phantom dimensions on HU values and its impact on dose calculations. The isodose distributions computed based on PCT and CBCT using the Catphan calibration curve agree to within ± 1% compared to that based on CBCT using the density phantom calibration curve. However, for phantoms of larger diameter, there is a pronounced discrepancy in the 50% and 60% isodose lines, with the dose difference being about ± 3%. For phantoms whose thickness is less than the cone beam scan length (16 cm) and for phantoms whose diameter is less than that of the calibration phantom, the variation in HU values is high. The effect of a change in radial diameter has a larger impact on dose calculations. This study shows that the CIRS density phantom is not suitable for CBCT calibration and that individual calibration curves obtained using phantoms of appropriate dimensions should be used for planning individual treatment sites.

Mechanical Simulation of Neural Electrode-Brain Tissue Interface Under Various Micromotion Conditions

Wenguang Zhang, Zhengwei Li, Merceron Gilles, Dongdong Wu

Micromotion is one of the most important factors that influence the long-term stability of neural electrodes. In order to improve the long-term stability of brain-implanted electrodes, this study uses finite element simulation for static and transient analyses. In particular, the effects of micromotion frequency and adhesion state on the mechanical state of the electrode-brain tissue interface are investigated based on the commercial electrode A1x16-3-100-413. The results demonstrate that micromotion frequency has a great effect on the maximum von Mises (VM) stress, revealing that higher frequencies are more harmful than lower frequencies in terms of the long-term stability of the electrode. When the frequency is 20 Hz, the stress reaches its maximum value, and then increases very slightly with frequency increasing. Results also show that the degree of physical coupling between the electrode and the brain tissue has a significant influence on the interfacial mechanical state. Enhancing the adhesion between the electrode and the brain tissue can effectively decrease the stress, strain, and delamination of the microelectrode tip with respect to the adjacent neural tissue, and thus improve the working life of implanted electrodes. The cyclic hysteresis energy is highly dependent on the adhesion of the electrode-tissue interface; the energy values are highest for a low electrode-tissue physical coupling. The results indicate that it is important to minimize the micromotion of the brain tissue caused by neural electrodes. A neural electrode with a biofouling-resistant coating should thus be developed to optimize the interface to enhance the adhesion between the brain tissue and electrodes.

Noninvasive Swallowing Test for Young Healthy Adults: Finding the Best Location to Monitor Thyroid Cartilage Movements

Chin-Man Wang, Chiung-Cheng Chuang, Carl PC Chen, Wen-Chun Tseng, Ji-Yih Chen

Noninvasive electrophysiological swallowing monitoring has become commonly used for swallowing studies due to its accuracy and lack of radiation exposure. Excursion of the thyroid cartilage plays a crucial role in airway protection during oropharyngeal swallowing. Therefore, monitoring this excursion is essential in swallowing studies. The level of the thyroid cartilage and the level at which cricothyroidotomy is performed are two locations at which piezoelectric sensors can be placed to measure excursion activities. This study aimed to find the best location for the placement of piezoelectric sensors for detecting thyroid cartilage excursion movements during noninvasive swallowing tests. Nineteen healthy young adults (9 men, 10 women), aged 20 to 32 years (mean: 24.5 ± 4.0 years), were recruited for the analysis of swallowing signals while drinking six different bolus volumes of water. The quantitative excursion signals of the thyroid cartilage integrated with the activities of the submental muscles were compared between the two piezoelectrical sensor placement locations and between men and women. Recording at the thyroid cartilage level showed higher excursion amplitude, earlier onset latency, and longer excursion duration under most bolus conditions compared to those recorded at the cricothyroidotomy level, although some conditions did not reach statistical significance. Earlier onset latency makes detecting the delayed latency in dysphagia easier, and higher amplitude facilitates signal detection on the skin surface. Thyroid cartilage recordings did not differ significantly between men and women. The data suggest that the thyroid cartilage level is more suitable for piezoe

Improved Intrinsic Motivation and Muscle Activation Patterns in Reaching Task Using Virtual Reality Training for Stroke Rehabilitation: A Pilot Randomized Control Trial

Shih-Chen Fan, Fong-Chin Su, Sheng-Shiung Chen, Wen-Hsuan Hou, Jui-Sheng Sun, Kung-Heng Chen, Wen-Hsiung Lin, Shang-Hwa Hsu

In long-term rehabilitation, stoke survivors might experience low motivation and poor adhesion to treatments. In such cases, off-the-shelf virtual reality (OTSVR) gaming systems can be a viable solution. The purpose of this exploratory study was to evaluate the effects of an affordable OTSVR treatment on patients' motivation and motor capacities. The ultimate goal is to apply the advantages of the OTSVR system to the design of future systems. Twenty participants completed the follow-up assessment. Four parallel groups received treatments for three weeks: 1) virtual reality (VR) via Wii gaming; 2) conventional therapy; 3) a placebo board game; 4) no treatment. The training effects were evaluated immediately after and four weeks after treatment. Surface electromyographic activity for a reaching task was obtained from five muscles, and the time-to-peak (TTP) contractions, time that a muscle takes to reach maximum contractions, was used as a kinesiological parameter. Any functional gains were evaluated using the Jebsen-Taylor Hand Function Test and the Stroke Impact Scale. The VR group immediately demonstrated significantly shorter TTP contractions in their biceps and flexor carpi radialis compared to the those of the board game and no treatment groups ($p < 0.05$). The TTP contraction change between the VR group and the conventional therapy group did not have significant differences. The VR group having a marginally retentional improvement in the deltoids ($p = 0.059$). No long-term benefits persisted in any other muscle. However, the VR group showed higher intrinsic motivation than those of the other groups. In this pilot study, OTSVR gaming had immediate effects on motor recovery and provided motivation for treatment compliance in stroke patients.

Development of Wideband Miniaturized Antennas Based on Fringe Field Capacitance Effects for Implantable MedRadio Band Biotelemetry

Chih-Kuang Wu, Tsung-Fu Chien, Chien-Min Cheng, Chin-Lung Yang, Ching-Hsing Luo

A compact meander planar inverted-F antenna (PIFA) with a broad bandwidth, miniature size, and low profile is proposed for implantable biotelemetry in the Medical Device Radiocommunications Service (MedRadio) band (401-406 MHz). The tuning mechanism of fringe field capacitance effects in human tissues on broadband impedance matching and size reduction is also investigated. Compared to existing miniature antennas, the proposed antenna has a 37% smaller volume and provides a 166% wider bandwidth by cutting partial substrate. For the antenna simulation and design, the proposed antenna was embedded into a simple box model (with box size of 55 × 55 × 20 mm3 and pork loin used as equivalent human tissue) and a male human body model (with Ansoft's accuracy of 4 mm). Experiments were also conducted. Although the proposed antenna occupies a volume of only 77 mm3 (7.8 × 7.8 × 1.27 mm3), the received power was as high as -47 dBm at 401 MHz. A communication link with distance of 1 m between the proposed implantable transmitting antenna and the exterior receiving monopole (one-quarter wavelength) antenna was set up.

國內研討會：

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- Rehacare & Orthopedic China 2015
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  http://www.chinaexhibition.com/Official_Site/11-6028-R_and_OC_2015_-_Rehacare_and_Orthopedic_China_2015.html

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  https://pei2015aesatema.wordpress.com/

- Toronto'2015 AES-ATEMA 25th International Conference
  Montreal, Canada. August 10 - 14, 2015.
  https://toronto2015aesatema.wordpress.com/

- The 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC'15)
  MiCo - Milano Conference Centor - Milan, Italy. August 25 - 29, 2015.
  http://embc.embs.org/2015/

- 13th International Conference of Numerical Analysis and Applied Mathematics (ICNAAM 2015)
  Rodos Palace Hotel, Rhodes, Greece. September 23 - 29, 2015.
  http://www.icnaam.org/

- Ottawa'2015 AES-ATEMA 26th International Conference
  Ottawa, Canada. October 12 - 16, 2015.
  https://astaa2015.wordpress.com

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