醫工學會 E-Newsletter

http://www.bmes.org.tw/
中華民國生物醫學工程學會
Taiwanese Society of Biomedical Engineering

April,2016
第18期

目錄

醫工學會秘書處：70101 台南市大學路一號
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【張冠諒教授紀念獎學金】

本學會 105 年度張冠諒教授紀念獎學金開始接受申請，申請日期自即日起至 2016 年 5 月 31 日截止（以郵戳為憑），請有意願申請者儘速將報名文件寄至：701 台南市東區大學路一號國立成功大學醫工系轉醫工學會。

更多訊息以及相關表單敬請參閱醫工學會網站最新消息：

http://www.bmes.org.tw/notice_show.php?id=218

【2016 中華民國生物醫學工程創意競賽】

為增進大專院校學生創意思考，培育人才對生物醫學工程之興趣及素質，提升團隊合作精神與結合學術與實務之能力，中華民國生物醫學工程學會今年將繼續舉辦生物醫學工程創意設計製作競賽，希望透過此競賽活動，能再強化各大專院校及社會各界對生物醫學工程科技的關注，訓練學生敏銳觀察，培養好奇心與探索問題的能力，提高創意思考空間，進而提高國家未來競爭力。

- 競賽組別

(A 組) 醫用電子與影像關鍵技術組;

(B 組) 醫用植入裝置與生醫材料組;

(C 組) 生物力學與輔具組

- 競賽時程

2016/6/1	**創意實作競賽書面報告開始收件**
2016/6/10	**創意實作競賽書面報告收件截止日**
2016/6/30	**公告創意實作競賽書面報告初審結果**
2016/7/15	**參加決賽隊伍，須繳交決賽 3000 元保證金**
2016/7/29	**創意實作競賽決賽(南部科學園區-高雄園區)**
2016/8/17-19	**得獎作品需於 2016GCBME 會議進行作品展示**

• 競賽獎金

特優一隊 5 萬元獎學金

優等三隊各 2 萬元獎學金

佳作 6 隊各 3000 元獎學金

【GCBME 2016 Call for Papers】

2016 Global Conference on Biomedical Engineering (GCBME 2016)

August 17-19, 2016. Taipei, Taiwan

It is our pleasure to remind you that the 2nd Global Conference on Biomedical Engineering (GCBME 2016) will take place in Taipei, Taiwan in August 2016. This meeting consists of daily plenary presentations followed by parallel sessions selected from submitted abstracts. Details and instructions for the conference can be found at the conference web site: Conference Website.

Topics of interest include (but not limited to):

- Biomaterials, Tissue Engineering, and Nanomedicine
- Biomechanics and Computational Bioengineering
- Medical Imaging, Biomedical Signal, and Bioinformatics
- Biophotonics and Bioelectronics
- Biosensing

- Medical Devices and Instrumentation
- Biomedical Robotics and Surgical Technology
- Neuroengineering and Clinical Engineering

Important Dates:

- Paper submission begin: March 1, 2016
- Paper submission due: April 15, 2016
- Notification of acceptance: May 15, 2016
- Accepted paper correction due: June 1, 2016

【2016 年醫工證書考試簡章】

2016 年臨床工程師、醫療設備技師、醫學工程師證書考試

報名日期：2016 年 4 月 15 日至 2016 年 7 月 1 日

筆試日期：2016 年 8 月 6 日(六) 上午 09:30-11:30

口試日期：2016 年 8 月 6 日(六) 下午 13:30-17:00 (暫訂)

考試地點：桃園縣中壢市中北路 200 號 中原大學

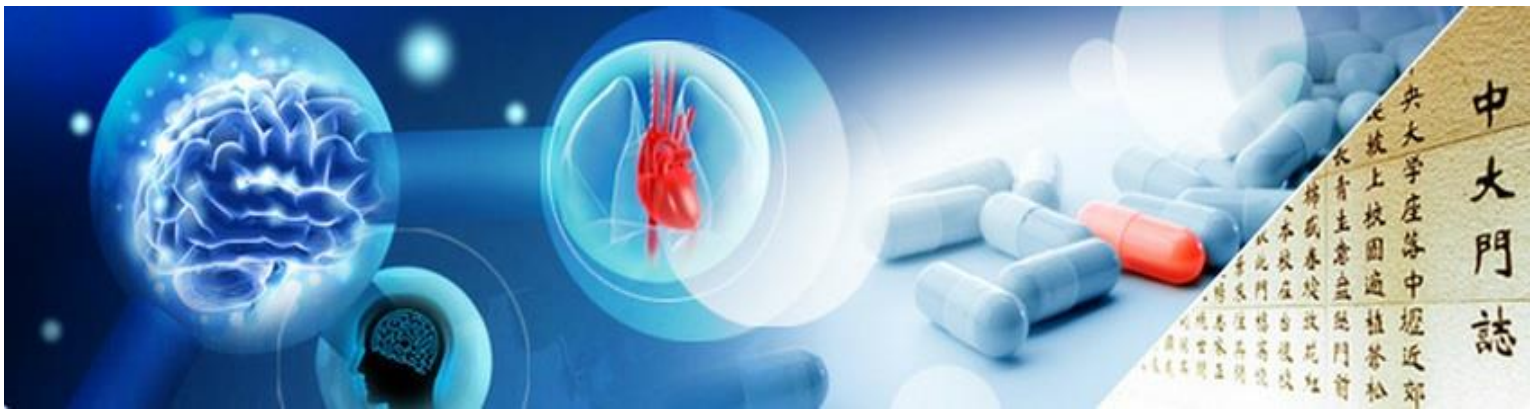
2016 年考試簡章.pdf

【學會核予教育學分公告】

本會於 2016 下半年度確定舉辦核予教育學分之活動以及研討會如下表所示，敬邀各位醫工先進以及同仁踴躍參與。教育學分相關最新公告可至醫工學會網站-研討會專區查詢。http://www.bmes.org.tw/seminar.php

日期	活動名稱	主辦單位	主要學分	輔助學分
2016/4/15	醫療器材上市後管理通報(第二場)	中原大學醫療器材科技轉譯中心		3
2016/4/22	105 年度醫學工程研討會	台灣私立醫療院所協會、彰化基督教醫院		3
2016/4/29	醫療器材上市後管理通報(第三場)	中原大學醫療器材科技轉譯中心		3
2016/8/17-19	GCBME 2016	陽明大學	20	

國立中央大學
生醫科學與工程學系
Department of Biomedical Sciences and Engineering



一、 系所簡介

「生醫科學與工程學系」成立於民國 104 年，由一個大學部及三個直屬研究所所組成；其中包含系統生物與生物資訊碩博士班、生物醫學工程碩博士班以及跨領域轉譯醫學博士班。秉持著「開創生命科學與醫學的新領域，實踐新科技對人類福祉的提升」之精神，「生醫科學與工程學系」成立之宗旨在於因應當前社會需求及生物科技與醫療照護產業的發展趨勢，以培育生醫產業跨領域人才為目標。並基於「破壞性創新」的概念，營造且整合基礎研究、技術研發與產學合作的教學研究環境。大學部目前每年招收 20 名理工類組的學生，而課程設計上強調生醫科學與工程技術的多元整合，以符合學界與業界的人才需求；研究所則依據進階專業分為三個班；包含系統生物與生物資訊碩博士班、生物醫學工程碩博士班以及跨領域轉譯醫學博士班，涵蓋以系統生物的技術方法研究生醫問題、將科學工程原理與技術運用於醫事操作，以及臨床醫學導向的轉譯醫學研究等方面，落實資源整合並強化針對產業需求的基礎研發能量。本系希望能吸納不同背景，但對基礎科學與前瞻技術具備高度熱情與學習能力，且兼俱對生命擁有好奇心與人道關懷的學生。整體教學重點與精神著重於：

1. 以跨領域教學方法培育嶄新世代的生醫人才。
2. 追求卓越的跨領域專題研究。大學部目前一年僅收 20 名新生，採精英制教學。

3. 理論與產業實務的結合以協助生醫產業升級，其中教學、研究及產業化為三項發展與整合
重點。

大學部課程設計強調生醫科學與工程技術的多元整合，大三、大四課程採多元選修制。同時鼓勵且提供學生各實驗室研究或業界實習機會，以符合學界與業界的人才培養需求，以落實資源整合並強化針對產業需求的基礎研發能量。目前本系擁有涵蓋生醫基礎科學與生醫/生物工程各領域之專門實驗室、大數據分析研究室、生物物理分析研究室、高通量生物化學研究室、細胞與分子醫學實驗室、臨床醫學實驗室、生物醫學工程綜合實驗室、生醫材料實驗室、生物醫學資訊研究室、穿戴式器材研究室、醫療器材實習工廠、雲端保健研究室等等。

畢業出路方面，大學部畢業生除可繼續直升本系碩士班或國內外生醫科技或其他相關科系之研究所繼續深造之外，其就業內容亦相當廣泛，例如 1)生醫科技產業中產品之研發、製造、認證、品質管理、生產管理、市場分析與產品行銷等實務工作，2)公私立生醫科技及其相關科系/國家政府機構等單位之研究人員，以及 3)報考相關公職人員考試。。

二、 師資與研究

■ 師資列表

姓名	職稱	最高學歷	學術專長
黃俊銘	教授兼系主任	國立台灣大學 生化分生所博士	■ 微生物總體 ■ 疫苗學 ■ 皮膚感染疾病
陳健生	副教授兼 副系主任	美國康乃爾大學 生化科技博士	■ 奈米生物感測科技 ■ 蛋白質體微陣列晶片 ■ 宿主-微生物相互作用 ■ 生醫化學
徐洵	講座教授兼院長	美國南卡羅萊納州立醫學大學分子生物學系博士	■ 癌症生物學 ■ 基質生物學
黃鍔	中研院院士暨 國鼎講座教授	美國約翰霍普金斯大學 流體力學博士	■ 數學家 ■ 流體力學家 ■ 海洋學家
李弘謙	生物物理 講座教授	加拿大麥基爾大學 物理學博士	■ 生物物理 ■ 計算生物 ■ 生物資訊
王孫崇	教授	美國紐約大學 物理學系博士	■ 微陣列分析 ■ 表觀基因體學 ■ 基因體學
羅孟宗	教授	國立臺灣大學 電信工程學系博士	■ 生醫訊號與影像處理 ■ 非線性系統分析 ■ 生醫電子電路設計
吳立青	副教授	國立中央大學 資訊工程學系博士	■ 資料探勘 ■ 生物資料庫 ■ 生物資訊學

姓名	職稱	最高學歷	學術專長
李宇翔	副教授	美國南加洲大學 化學工程博士	■ 細胞/組織工程 ■ 基因轉殖 ■ 生物反應器 ■ 醫學分子檢驗技術
馬念涵	副教授	美國耶魯大學 實驗病理所博士	■ 癌症生物學 ■ 訊息傳遞網路 ■ 藥物研發
陳純娟	副教授	英國倫敦大學 影像神經科學博士	■ 計算神經科學 ■ 腦電磁波訊號處理 ■ 運動控制
吳昌衛	副教授	國立臺灣大學 電機工程學博士	■ 功能性磁振造影 ■ 大腦功能之生理模型 ■ 醫學影像處理
黃俊仁	副教授	德國邁茲大學 分子生物物理博士	■ 高分子醫學材料 ■ 功能性生物介面 ■ 光學生物感測器
蘇立仁	助理教授	國防大學醫學院 生命科學系博士	■ 生物資訊、基因體 ■ 癌症細胞學 ■ 中藥與新藥開發
陳健章	助理教授	國立交通大學 電子研究所博士	■ 生醫微機電系統整合 ■ 計算物理與工程科學建模 ■ 大資料與機械學習
林澂	助理教授	國立中央大學 系統生物與生物資訊博士	■ 醫學生理學 ■ 醫學訊號處理 ■ 轉譯醫學
劉淑貞	助理教授	國防大學醫學院 生命科學博士	■ 腫瘤微環境 ■ 癌症治療抗性分子機制 ■ 癌症轉譯醫學

■ **系統生物與生物資訊碩/博士班**：

- 癌症之基質生物學與訊息傳遞網路
- 表觀基因體的甲基化調控機制
- 基因、藥物、疾病網絡
- 多種蛋白質微陣列晶片研發與應用
- 幹細胞、誘導性幹細胞、癌幹細胞發育、分化、重編程之調控機制
- 中草藥研發

■ **生物醫學工程碩/博士班**：

- 細胞分子生物工程：基因/蛋白質表現分析、生物反應器、細胞生物工程
- 生醫材料：藥物載體研發，生醫材料表面處理
- 生醫影像/訊號與感測：生醫訊號處理、生醫光電感測
- 醫療器材與科技輔具：電腦輔助診斷與手術導引系統

■ **跨領域轉譯醫學博士班**：

- 電腦科學、醫療儀器、資料分析、計算數學
- 生醫訊號與影像處理、非線性系統、生醫電子電路設計

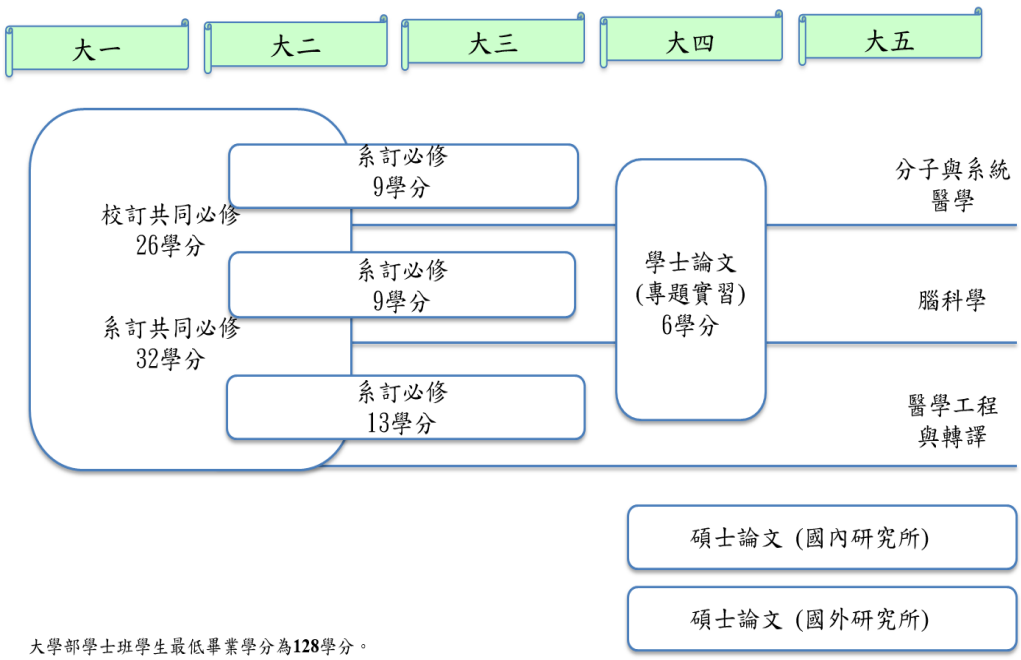
- 統計物理、理論生物物理、時間序列、物理數學、流體力學
- 電腦輔助醫學、設計自動化
- 醫學生理學、轉譯醫學
- 生醫微機電、計算物理、機械學習

三、課程規劃

生醫科學與工程學系大學部課程規劃:

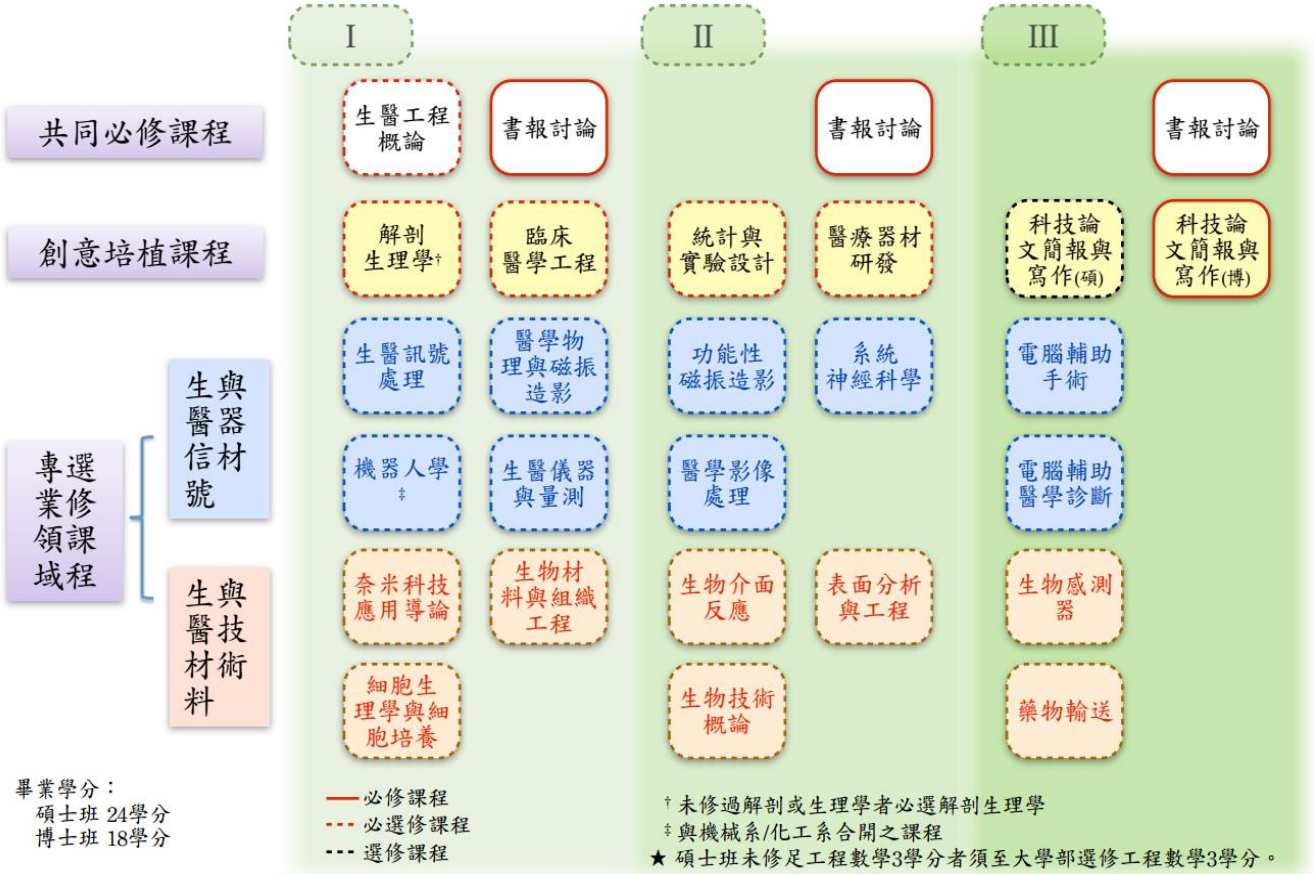
生醫系課程設計提供大一不分組學生初步了解各項生醫科學與工程技術的實際研究方法。介紹其必要的科學基礎、實驗及程式實作，讓學生在大二分組前能夠了解未來分組所需的知識與技術。大二分組課程除了提供進階實驗研究方法與基礎理論的延伸教學，更強調在實驗設計及操作、程式實作的訓練，培養學生獨立規劃到運作完整的實驗為目標，每項課程皆提供不同面向的研究訓練，旨在建立學生正確的研究思維，達到學用合一的成效。並強化來自各產業界（包括生技、製藥、醫療、器材、智財權等）教師，提供業界的實務經驗分享與實習機會，也將新聘授課和研究專長能連結生科及醫工兩個領域的教師，以開設跨領域的選修課程。此外，藉由跨領域轉譯醫學博士班和生物醫學工程碩博班聘任的多位臨床醫師，共同開設生命科學和醫學工程在臨床上的重大挑戰與應用之相關課程；在智財權方面，則會聘請法律事務所的律師和生物產業之法務專家、專業經理人及研發人員兼任授課，這些都可強化學生就業的能力。適材的人力進入產業，產業的提升才會有效率。

生醫科學與工程學系 課程流程圖

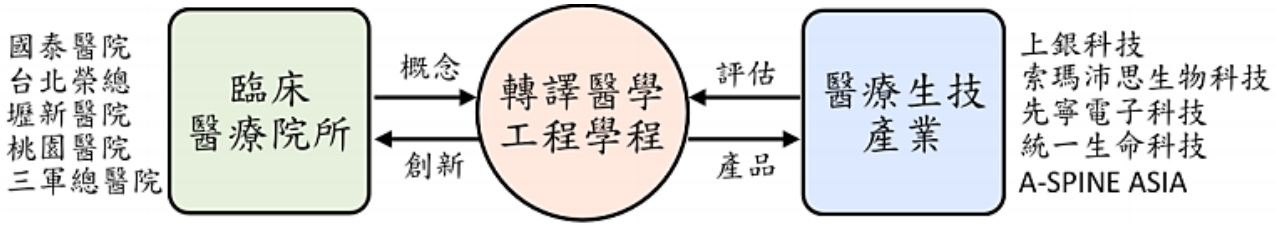


大學部學士班學生最低畢業學分為**128**學分。
第一學年、第二學年及第三學年每學期至少16學分，
第四學年每學期至少9學分。

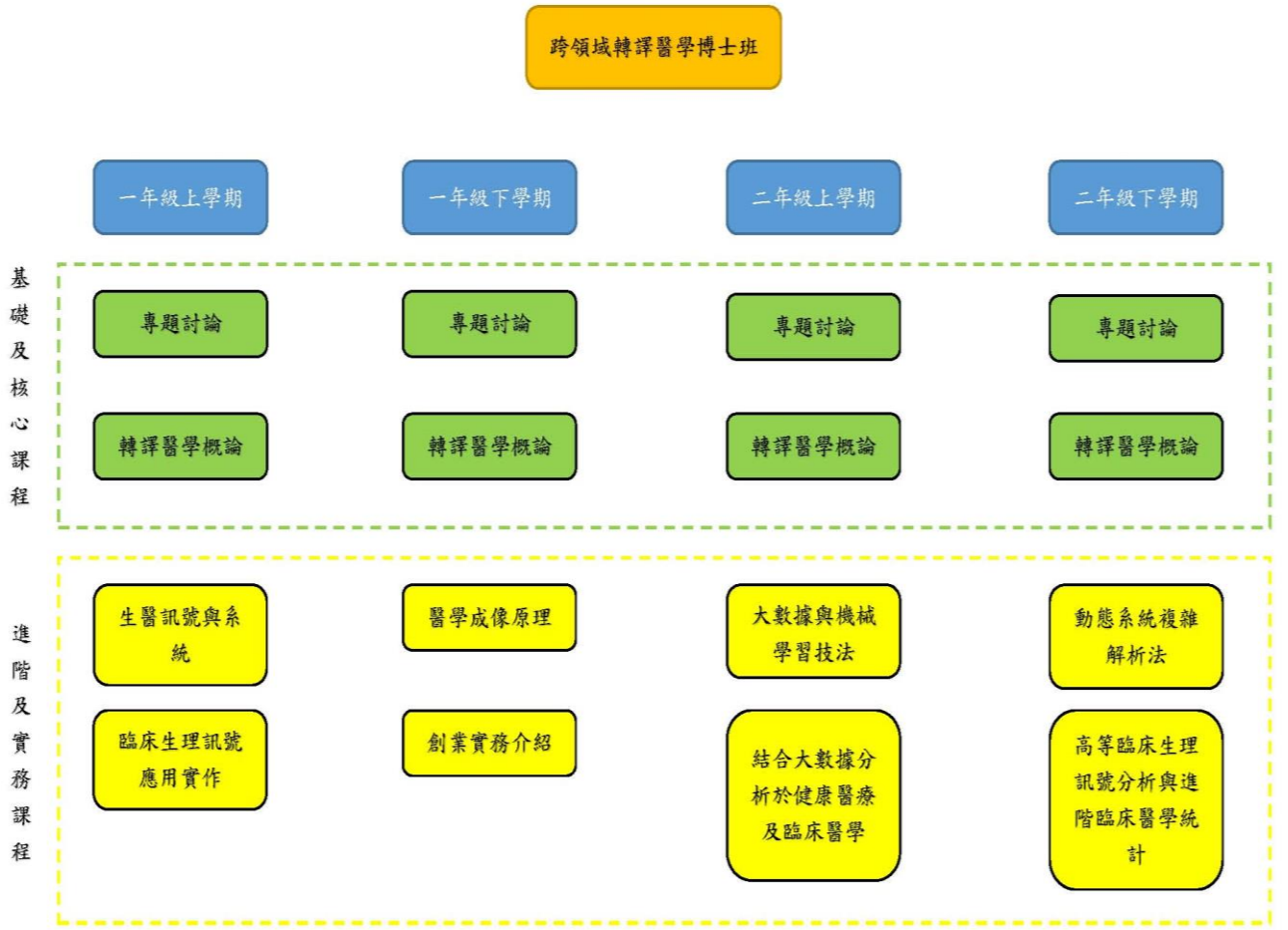
■ **生物醫學工程碩/博士班：**



☐ **生物醫學工程碩/博士班實務型課程規畫**



■ **跨領域轉譯醫學博士班**：



四、學生生活

◆ 迎新活動(大一新生座談會、迎新宿營)






◆ 專題演講, 促進業界與學界的交流

◆ 導生活動交流聚會

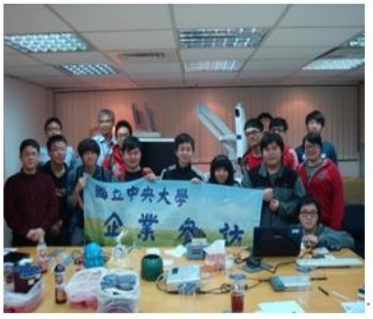
◆ 學生生活

◆ 學校運動會展現活力

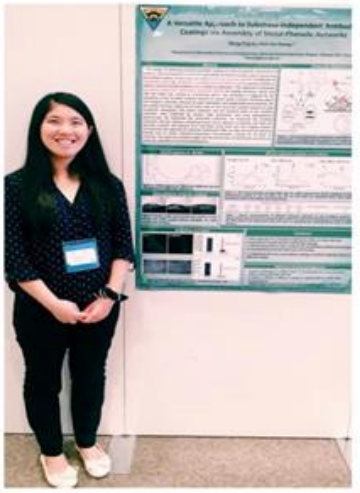
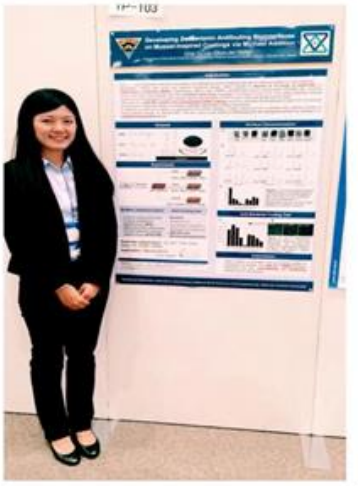
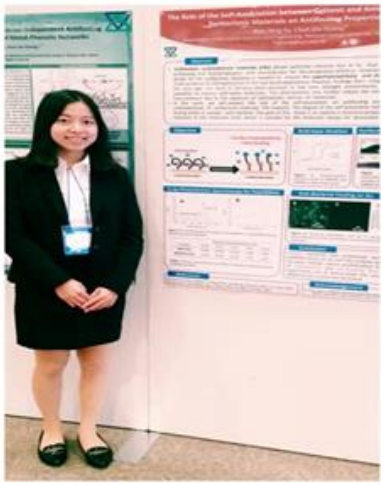




◆ 校外實習與企業參訪




◆ 參加國內外會議、競賽

◆ 畢業送舊活動






五、結語

生醫研究與醫療照護產業是 21 世紀的科學及經濟發展主軸。
中央大學之生醫科學與工程學系將致力成為主導此發展之智庫與領導人材培育基地。
期望與有志同學共同努力。

竭誠歡迎全國優秀人才加入本系，培育成為生醫產業及學術研究單位之精英分子

聯絡方式

網址: http://dbse.ncu.edu.tw/
地址:桃園市中壢區中大路 300 號 中央大學生醫科學與工程學系
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醫療器材法規訓練與輔導

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很榮幸能在此向各位介紹一個陌生的行業“醫材法規顧問”。這項工作既不需要西裝筆挺跑業務，也不需要埋首實驗室做研究，有時打打電腦上上網，只要動動嘴就可以完成任務，隨著網路的興盛使用手機或平板 Anytime & Anywhere 都可以工作，聽起來是不是讓人很心動?

因為醫療器材和藥品一樣都是人命關天的產品，做得好、賣得對就是名利雙收；但設計不良、品質不佳或被濫用時，一旦出了人命，那可就傾家蕩產，有打不完的官司，一輩子良心不安。所以在大部分的國家，政府都會制定一套法規來管理醫療器材的上市及使用，而這些法規繁瑣、多如牛毛，若沒有專人費一番功夫篩選整理及詳細了解，廠商很容易就會忽略法規的要求，輕則產品被要求下架及暫停生產，重則負責人員會有法律責任，千萬不可輕忽

一般而言，醫療器材業者不管是代理商或是製造工廠都會聘請處理法規事務的人員(Regulatory Affairs, 簡稱 RA)，可能是專職或兼職人員，從工程師、專員一直到協理職都有，端看公司營業規模或產品法規的需求度而定。若各位同學有興趣想了解法規職位的相關資訊，可直接到 104 或 1111 等求職網站上搜尋醫療器材法規就可以找到相關的職缺，對於工作經歷及學歷要求，通常醫工相關科系是最受歡迎的；其次是語文條件，英文是基本條件，若是日商會額外要求日語能力；至於工作內容，不外乎特定國家醫療器材證照申請，若是在台代理商或分公司，則是需要 RA 人員向國外原廠要求提供申請資料，由 RA 人員將文件彙整一一確認，或是語文的翻譯，最後送交台灣衛福部所屬的食品藥物管理局(簡稱 TFDA)。此外，RA 人員還需要在文件審查期間與審查人員持續溝

通，身為原廠及 TFDA 的橋樑，需耐心處理繁雜的文書工作直到許可證照核發。台灣製造工廠的 RA 負責的事就更多了，視產品外銷國家而定，不同國家在時間和程序皆有不同的要求，因此廠商會視需要聘請顧問來提供專業諮詢，協助 RA 人員應付各國的規定。

在 96 年應政策需求成立科技化照護專案，政府於經濟部南部創新園區設立數個研發中心，研發可應用於醫療器材的技術，其中一個工研院的研發據點距離成功大學約 30 分鐘車程。本人有幸能在這個單位擔任醫療器材法規研究，一來協助 RD 同仁在研發初期即導入法規的要求，二來也協助技轉的廠商在生產販售前順利符合法規拿到許可證照。近年來南部醫療器材的產業聚落逐漸擴大，成功大學也投入不少學界能量開發高階的醫療器材，承蒙醫工所老師的賞識，本人也開始協助成大醫材創新團隊公司化、商品化，與相關法規的訓練及輔導。值得高興的是，每次的演講或 workshop 都會遇到許多自願報名的醫工所學生，主動提出問題，對醫療器材法規研究展現高度興趣，也希望日後能擴及到更多學校醫工系所的同學，幫助本專業人才更了解醫材領域不同的職場生涯。

如要成為專業的法規顧問，個人的心得是語言是關鍵。相較於其他國家，台灣的醫材製造業者外語能力較弱，很多公司往往指派英文能力最強的同仁負責法規工作；如在外商更不用講，所有的信件溝通都是用英文，所以若各位在求學期間能把英文基礎打好，累積醫療專有名詞，對於未來閱讀法規文件是很有幫助的。其次就是回歸到醫材專業，法規人對醫材要廣博涉略，進入公司後再針對自家產品深入研究。學校的基礎課程是十分有幫助的，因為法規文件裡很重要的是臨床用途及產品技術說明，特別是應用到的基本科學原理，若在校時能奠定不錯的基礎，將來撰寫或閱讀技術報告時會比非醫材科系的人輕鬆許多。講了這樣多，最重要的還是要看個人的興趣，對醫學、醫療是否有知的欲望，是否認同從事醫材業和醫護人員一樣都是救人的工作。能協助品質好的醫療器材順利上市以供醫護人員使用，是這個工作最有成就感的地方。

預計到了 2100 年，地球人口將再增加 40 億人，人類的平均壽命也持續增加。世界衛生組織（WHO）預測，到了 2025 年全球 63%人口會超過 65 歲，對於醫療器材的需求也不斷提高。全球醫療器材市場超過 2000 億美元，每年以大於 7%複合成長率成長，因此醫材這個行業再過個數十年不但不會退流行，反而會穩定成長。醫材法規訓練與輔導，將是前景看好的工作，甚至到國外去工作也是很有機會的。期許國內更多醫工人才能一同加入，成為醫療法規的生力軍！

February 2016, Volume 36, Issue 1, pp 1-11

The Three Laws of Neurorobotics: A Review on What Neurorehabilitation Robots Should Do for Patients and Clinicians

Marco Iosa , Giovanni Morone, Andrea Cherubini, Stefano Paolucci

Abstract

Most studies and reviews on robots for neurorehabilitation focus on their effectiveness. These studies often report inconsistent results. This and many other reasons limit the credit given to these robots by therapists and patients. Further, neurorehabilitation is often still based on therapists' expertise, with competition among different schools of thought, generating substantial uncertainty about what exactly a neurorehabilitation robot should do. Little attention has been given to ethics. This review adopts a new approach, inspired by Asimov's three laws of robotics and based on the most recent studies in neurorobotics, for proposing new guidelines for designing and using robots for neurorehabilitation. We propose three laws of neurorobotics based on the ethical need for safe and effective robots, the redefinition of their role as therapist helpers, and the need for clear and transparent human–machine interfaces. These laws may allow engineers and clinicians to work closely together on a new generation of neurorobots.

February 2016, Volume 36, Issue 1, pp 12-21

Classification Scheme for Arm Motor Imagery

Mojgan Tavakolan, Xinyi Yong, Xin Zhang, Carlo Menon

Abstract

Facilitating independent living of individuals with upper extremity impairment is a compelling goal for our society. The degree of disability of these individuals could potentially be reduced by using robotic devices that assist their movements in activities of daily living. One approach to control such robotic systems is the use of a brain–computer interface, which detects the user's intention. This study proposes a method for estimating the user's intention using electroencephalographic (EEG) signals. The proposed method is capable of discriminating rest from various imagined arm movements, including grasping and elbow flexion. The features extracted from EEG signals are autoregressive model coefficients, root-mean-square amplitude, and waveform length. Support vector machine was used as a classifier, distinguishing class labels corresponding to rest and imagined arm movements. The performance of the proposed method was evaluated using cross-validation. Average accuracies of 91.8 ± 5.8 and 90 ± 4.1 % were obtained for distinguishing rest versus grasping and rest versus elbow flexion. The results show that the proposed scheme provides 18.9, 17.1, and 16.5 % higher classification accuracies for distinguishing rest versus grasping and 21.9, 17.6, and 18.1 % higher classification accuracies for distinguishing rest versus elbow flexion compared with those obtained using filter bank common spatial pattern, band power, and common spatial pattern methods, respectively, which are widely used in the literature.

February 2016, Volume 36, Issue 1, pp 22-31

Hemodynamic Pattern Recognition During Deception Process Using Functional Near-infrared Spectroscopy

Roberto Vega , Ana G. Hernandez-Reynoso, Emily Kellison Linn, Rita Q. Fuentes-Aguilar, Gildardo Sanchez-Ante, Arturo Santos-Garcia, Alejandro Garcia-Gonzalez

Abstract

Deception is considered a psychological process by which one individual deliberately attempts to convince another person to accept as true what the liar knows to be false. This paper presents the use of functional near-infrared spectroscopy for deception detection. This technique measures hemodynamic variations in the cortical regions induced by neural activations. The experimental setup involved a mock theft paradigm with ten subjects, where the subjects responded to a set of questions, with each of their answers belonging to one of three categories: Induced Lies, Induced Truths, and Non-Induced responses. The relative changes of the hemodynamic activity in the subject's prefrontal cortex were recorded during the experiment. From this data, the changes in blood volume were derived and represented as false color topograms. Finally, a human evaluator used these topograms as a guide to classify each answer into one of the three categories. His performance was compared with that of a support vector machine (SVM) classifier in terms of accuracy, specificity, and sensitivity. The human evaluator achieved an accuracy of 84.33 % in a tri-class problem and 92 % in a bi-class problem (induced vs. non-induced responses). In comparison, the SVM classifier correctly classified 95.63 % of the answers in a tri-class problem using cross-validation for the selection of the best features. These results suggest a tradeoff between accuracy and computational burden. In other words, it is possible for an interviewer to classify each response by only looking at the topogram of the hemodynamic activity, but at the cost of reduced prediction accuracy.

February 2016, Volume 36, Issue 1, pp 32-43

SPECT Imaging of 2-D and 3-D Distributed Sources with Near-Field Coded Aperture Collimation: Computer Simulation and Real Data Validation

Zhiping Mu, Lawrence W. Dobrucki, Yi-Hwa Liu

Abstract

The imaging of distributed sources with near-field coded aperture (CA) remains extremely challenging and is broadly considered unsuitable for single-photon emission computerized tomography (SPECT). This study proposes a novel CA SPECT reconstruction approach and evaluates the feasibilities of imaging and reconstructing distributed hot sources and cold lesions using near-field CA collimation and iterative image reconstruction. Computer simulations were designed to compare CA and pinhole collimations in two-dimensional radionuclide imaging. Digital phantoms were created and CA images of the phantoms were reconstructed using maximum likelihood expectation maximization (MLEM). Errors and the contrast-to-noise ratio (CNR) were calculated and image resolution was evaluated. An ex vivo rat heart with myocardial infarction was imaged using a micro-SPECT system equipped with a custom-made CA module and a commercial 5-pinhole collimator. Rat CA images were reconstructed via the three-dimensional (3-D) MLEM algorithm developed for CA SPECT with and without correction for a large projection angle, and 5-pinhole images were reconstructed using the commercial software provided by the SPECT system. Phantom images of CA were markedly improved in terms of image quality, quantitative root-mean-squared error, and CNR, as compared to pinhole images. CA and pinhole images yielded similar image resolution, while CA collimation resulted in fewer noise artifacts. CA and pinhole images of the rat heart were well reconstructed and the myocardial perfusion defects could be clearly discerned from 3-D CA and 5-pinhole SPECT images, whereas 5-pinhole SPECT images suffered from severe noise artifacts. Image contrast of CA SPECT was further improved after correction for the large projection angle used in the rat heart imaging. The computer simulations and small-animal imaging study presented herein indicate that the proposed 3-D CA SPECT imaging and reconstruction approaches worked reasonably well, demonstrating the feasibilities of achieving high sensitivity and high resolution SPECT using near-field CA collimation.

February 2016, Volume 36, Issue 1, pp 44-52

Clinical Pedicle Screw Insertion Trials and System Improvement of C-arm Image Navigation System

Chih-Ju Chang, Ching-Hsiao Yu, Geng-Li Lin, Alex Tse, Hong-Yu Chu, Ching-Shiow Tseng

Abstract

C-arm-image-assisted navigation systems for orthopedic surgery have been applied clinically for several years. Pedicle screw implantation is one of the important applications. A precise definition of a C-arm X-ray projection model is the key requirement for a C-arm-assisted navigation system. This study proposes using a high-pass filter to extract the contour of large markers of the image calibrator and an adaptive threshold method to segment images of small markers, thus improving the overall recognition rate of markers and enhancing the robustness of image calibration. A method for time synchronization of X-ray imaging and the detection of a patient's lumbar position data for respiration compensation is also proposed. Positioning accuracy evaluation of the developed C-arm-assisted navigation system was carried out clinically. The results show that the mean positioning error is 2.409 mm and that the mean direction error is 1.449°.

February 2016, Volume 36, Issue 1, pp 53-61

16-Channel Surface Coil for 13C-Hyperpolarized Spectroscopic Imaging of Cardiac Metabolism in Pig Heart

Francesca Frijia, Maria Filomena Santarelli, Ulrich Koellisch, Giulio Giovannetti, Titus Lanz, Alessandra Flori, Markus Durst, Giovanni Donato Aquaro, Rolf F. Schulte and 6 more

Abstract

Magnetic resonance spectroscopy (MRS) of hyperpolarized 13C pyruvate and its metabolites in large animal models is a powerful tool for assessing cardiac metabolism in patho-physiological conditions. In 13C studies, a high signal-to-noise ratio (SNR) is crucial to overcome the intrinsic data quality limitation due to the low molar concentration of certain metabolites as well as the low flux of conversion. Since 13C-MRS is essentially a semi-quantitative technique, the SNR of the spectra acquired in different myocardial segments should be homogeneous. MRS coil design plays an important role in achieving both targets. In this study, a 16-channel receive surface coil was designed for 13C hyperpolarized studies of the pig heart with a clinical 3-T scanner. The coil performance was characterized by phantom experiments and compared with that of a birdcage coil used in transmit/receive mode. Segmental signal distribution in the left ventricle (LV) was assessed by experiments on six healthy mini pigs. The proposed coil showed a significant increase in SNR for the LV wall close to the coil surface with respect to that for the birdcage but also significant segmental inhomogeneity. Hence, the use of the 16-channel coil is recommended for studies of septal and anterior LV walls.

February 2016, Volume 36, Issue 1, pp 62-70

A Clinical and Kinematical Evaluation of Trajectory Planning Software for Posterior Atlantoaxial Transarticular Screw Fixation Surgery

Andy Chien , Yao-Hung Wang , Dar-Ming Lai , Ying-Sian Chen, Wen-Kai Chou, Been-Der Yang, Jaw-Lin Wang

Abstract

Atlantoaxial instability is a progressive cervical spine condition that often requires surgical intervention. The posterior C1-2 transarticular fixation has been a great advancement for the management of atlantoaxial instability as it provides improved biomechanical stability. However, the surgical risks of serious neurovascular injury associated with this technique remain an obstacle for its wider adoption. The goal of this study is to evaluate the surgical outcome of C1-2 transarticular screw fixation utilizing a lab-designed trajectory planning software (TPS) system and to investigate the likely kinematical impact of deviated screw trajectory. The TPS system was applied to 19 patients (mean age: 61.1 years, range: 35–71 years; 14 males and 5 females) that underwent C1-2 transarticular fixation at our institution. A total of 32 transarticular screws were inserted. Pre-operative computed tomography images were used to render a three-dimensional bone tissue model as well as the corresponding multi-planar digitally reconstructed radiographs. The pre- and post-operative positions of C1 and C2 were also compared. Overall, only one malpositioned screw was identified and no major complications occurred for any of the patients. A comparison of the planned and actual screw insertion trajectories indicated that the vertical angle was the only parameter to have a statistically significant difference. Moderate negative correlation was found between the vertical entry point and the vertical angle, and moderate positive correlation was found between the horizontal entry point and the horizontal angle. The TPS system is a cost-effective clinical implementation that can potentially reduce the associated complication rates for C1-2 transarticular fixation. The system should be viewed as a useful assistive device as well as a potential training and auditing tool for institutions where more expensive navigational systems are not readily available.

February 2016, Volume 36, Issue 1, pp 71-79

Preliminary Study of Assessing Bladder Urinary Volume Using Electrical Impedance Tomography

Rihui Li, Jinwu Gao , Yaning Li, Junpeng Wu, Zhanqi Zhao, Yang Liu

Abstract

A non-invasive method based on electrical impedance tomography (EIT) is presented for the continuous assessment of human bladder urinary volume. An EIT system developed for bladder urinary volume imaging is first introduced. To validate the system and to examine the feasibility of estimating bladder fullness with EIT, an ex vivo experiment with four porcine bladders and an observational study of bladder urine filling in six healthy volunteers was conducted. Four porcine bladders were filled with saline solution with various concentrations and separately placed in a cylindrical tank. Each bladder was filled from 0 to 600 ml in increments of 100 ml. EIT measurements were performed and the maximum diameters of the bladders were recorded. For the observational study, bladder filling from empty to the status of strong micturition desire was monitored by EIT. The average conductivity index (ACI) was derived from the EIT images to quantify the bladder filling. For comparison, a four-electrode method, which is described in previous studies, was also applied. The results show a high positive linear correlation between the ACI and the bladder urinary volume in all subjects (correlation coefficient $R = 0.98 \pm 0.01$, $p < 0.001$), with the performance of the four-electrode method being much poorer (correlation coefficient $R = -0.27 \pm 0.82$, $p < 0.001$). This study demonstrates that EIT has the ability to distinguish bladder urinary volumes and thus has potential as a practical and effective technique for assessing bladder urinary volume.

February 2016, Volume 36, Issue 1, pp 80-86

Quantification of In Vivo Kinematics of Superficial Femoral Artery due to Hip and Knee Flexion Using Magnetic Resonance Imaging

Gilwoo Choi , Christopher P. Cheng

Abstract

The objective of this study is to quantify the in vivo kinematics of the superficial femoral artery (SFA) caused by hip and knee flexion by utilizing vascular and skeletal magnetic resonance (MR) imaging and image processing methods. Seven male healthy volunteers (56 ± 5 years old) were imaged using contrast-enhanced MR angiography in the supine and bent-leg positions using a GE Signa Excite 1.5-T scanner. Coregistered SFA coordinates from these two body positions provide the relative motion of the SFA with respect to the femur as a result of hip and knee flexion. With 86 ± 6° hip and 39 ± 6° knee flexion angles, the proximal portion of the SFA moved significantly inferiorly while the distal portion of the SFA stayed immobile in relation to the femur due to hip and knee flexion. From the supine position to the bent-leg position, the top of the SFA moved 23.5 ± 7.0 mm closer to the bottom of the SFA ($p < 0.05$), resulting in shortening and buckling of the SFA. The differential translations of points along the SFA indicate shortening and buckling along the length of the vessel. They also indicate that the SFA is more tethered to the bony structures at the knee compared to the thigh. The in vivo SFA kinematics obtained in this study provides insight into the interaction between the SFA and the surrounding musculoskeletal structures.

February 2016, Volume 36, Issue 1, pp 87-95

Assessment of Microvascular Function Using Near-Infrared Spectroscopic 2D Imaging of Whole Hand Combined with Vascular Occlusion Test

Valentina Hartwig , Martina Marinelli, Fabrizio Rocco, Antonio L'Abbate

Abstract

Near-infrared spectroscopy (NIRS) is an optical technique able to assess blood oxygen saturation (StO2) non-invasively. StO2 of peripheral blood (blood contained in small vessels in strict contact with tissue cells) reflects the adequacy of blood flow and O2 supply for tissue metabolism. Recent studies have tested the clinical utility of NIRS for studying peripheral microcirculation with the use of a NIRS probe, exploring a limited portion of hand skin (generally the thenar eminence), combined with vascular occlusion testing (VOT). In order to gain information from much larger tissue areas, the present study evaluates the possibility of using a NIRS two-dimensional (2D) camera for whole-hand imaging. Twelve healthy adults were tested. A NIRS camera was used to acquire the hemoglobin StO2 2D mapping of the whole-hand inner surface during VOT. Several parameters were calculated from the StO2 trend obtained from the NIRS image set, using two exemplifying regions of interest on the thenar eminence and the middle finger.

February 2016, Volume 36, Issue 1, pp 96-104

Trabecular Bone Morphological Analysis for Preclinical Osteoporosis Application Using Micro Computed Tomography Scanner

David Shih-Chun Jin, Chien-Hao Chu, Jyh-Cheng Chen

Abstract

Trabecular bone morphological parameter (TMP) analysis with micro computed tomography (micro-CT) has been used to evaluate the risk of fracture of osteoporosis in small animals. Many researchers have pointed out the drawback of making decisions based on bone mineral density only due to the lack of morphological information. Our study describes the application of a laboratory micro-CT system and a self-designed TMP algorithm combined with two statistical methodological tools for the evaluation of the artificially induced animal model by the ovariectomy (OVX) surgery process. The results show that the percentage bone volume (BV/TV), the trabecular properties thickness (Tb Th), number (Tb N), and separation (Tb Sp) have significant differences between the normal and OVX groups. Tb Th and Tb Sp had very low p-values and are associated with bone loss caused by osteoporosis. The method can be used to early detect osteoporosis to prevent the risk of fracture in aging small animals.

February 2016, Volume 36, Issue 1, pp 105-109

Innovative Apparatus for Quantitatively Evaluating Effectiveness of Cervical Orthosis and Cervical Thoracic Orthosis

Fan Gao , Bill Carlton

Abstract

Accurate and objective evaluation of the effectiveness of cervical orthosis and cervical thoracic orthosis in restricting neck motion is essential for making clinical decision. Existing methodologies, however, are either not cost-effective or incapable of offering consistent and/or objective outcomes. The objective of this study was to develop and evaluate a cost-effective apparatus which is capable of delivering controllable loading to the head and neck in all three anatomical planes. The apparatus consists of a custom helmet and an instrumented T-handle, allowing the experimenter to apply a force couple in each of the three anatomical planes. Twenty-seven young healthy subjects participated in the evaluation study with cervical orthosis and cervical thoracic orthosis. Four trials were conducted in each plane and the signals of torque and three-dimensional motion sensors were collected simultaneously. Intra-class correlation coefficients (ICCs) of intra-rater reliability ranged from 0.916 to 0.996 for flexion, extension, and lateral bending. ICCs of intra-rater reliability ranged from 0.762 to 0.967 for axial rotation. ICCs of loading and unloading were comparable across test conditions. A similar pattern was revealed in inter-rater reliability. When the experimenter held the T-handle using both hands, a force couple formed, producing a primarily rotary effect. The relatively low reliability in axial rotation might be attributed to the deficiency of cervical orthoses in effectively restricting neck motion in the transverse plane. The apparatus will be a useful tool and offer both quantitative and objective biomechanical evaluation of cervical orthoses.

February 2016, Volume 36, Issue 1, pp 110-120

Analysis of Flow Field in Mechanical Aortic Bileaflet Heart Valves Using Finite Volume Method

Feng Zhou, Yuan Yuan Cui, Liang Liang Wu, Jie Yang, Li Liu, Manfred F. Maitz, Ian G. Brown, Nan Huang

Abstract

Under physiological conditions, the opening and closing of the leaflets of an implanted artificial heart valve (AHV) affects the blood components and therefore may cause various complications to the patient such as hemolysis or platelet activation. In this paper, a computational fluid model is presented. The regional distribution of flow shear stress in an AHV is analyzed using computational fluid dynamics and AHV performance is evaluated in terms of the variation of flow velocity and pressure when blood passes the leaflets in the aortic valve. The results suggest that for the design of a mechanical AHV, the maximum opening angle and internal orifice diameter should be increased to improve the fluid structure interaction and decrease the possibility of damage to blood components. Finally, the fluid stress distribution of the AHV leaflet structure was calculated and analyzed under pulsating flow conditions.

February 2016, Volume 36, Issue 1, pp 121-131

Muscle Strength Assessment System Using sEMG-Based Force Prediction Method for Wrist Joint

Songyuan Zhang , Shuxiang Guo, Baofeng Gao, Qiang Huang, Muye Pang, Hideyuki Hirata, Hidenori Ishihara

Abstract

Tele-assessment systems are crucial for home-based rehabilitation, as they allow therapists to assess the status of patients and adjust the parameters of various home-based training devices. Traditional force/torque sensors are commonly used in tele-assessment systems to detect muscle strength because such sensors are convenient. However, muscle activity can be measured using surface electromyography (sEMG), which records the activation level of skeleton muscles and is a more accurate method for determining the amount of force exerted. Thus, in this paper, a method for predicting muscle strength using only sEMG signals is proposed. The sEMG signals measure the isometric downward touch motions and are recorded from four muscles of the forearm. The prediction function is derived from a musculoskeletal model. The parameters involved are calibrated using the Bayesian linear regression algorithm. To avoid the complex modeling of the entire movement, a neural network classifier is trained to recognize the force-exerting motion. Experimental results show that the mean root-mean-square error of the proposed method is below 2.5 N. In addition, the effects of the high-pass cutoff frequency and the co-activation of flexors and extensors for EMG force prediction are discussed in this paper. The performance of the proposed method is validated further in real-time by a remote predicted-force evaluation experiment. A haptic device (Phantom Premium) is used to represent the predicted force at the therapist's remote site. Experimental results show that the proposed method can provide acceptable prediction results for tele-assessment systems.

February 2016, Volume 36, Issue 1, pp 132-143

Maneuverable Capsule Endoscope Based on Gimbaled Ducted-Fan System: Concept and Simulation Results

Myungjoon Kim, Chiwon Lee, Yongwoo Lee, Chulwoo Park, Youdan Kim, Sungwan Kim

Abstract

Wireless capsule endoscopes are a growing research area because they can be easily swallowed by patients to capture images of the digestive system without pain. However, a drawback of current capsule endoscopes is that most use passive motion. To overcome this drawback, a maneuverable capsule endoscope (MCE) based on a gimbaled ducted-fan (GDF) system is proposed in this study. The system design, prototype development of the GDF system, and associated modeling and simulation are presented. The concept of the GDF is adopted from the thrust-vector control algorithm of a space shuttle. To prevent organ damage, the ducted fan, which generates and controls the thrust required for achieving maneuverability, is mounted on a gimbal structure. A scaled-up prototype of the GDF system was manufactured. The overall conceptual design of the MCE based on the GDF system is presented. A flow simulation and a three-dimensional path-following simulation are performed to evaluate the proposed MCE's applicability. The mean terminal velocity of the 6:1 scaled-up MCE prototype was calculated from flow simulation to be 0.6047, 0.5941, and 0.9204 m/s for the three postures of the GDF system, respectively, which represented the three translational degrees of freedom. For the 1:1 scale prototype, the mean terminal velocity was calculated to be 0.1147, 0.1127, and 0.1746 m/s for the above three postures, respectively. The proposed MCE dynamic model follows the desired path profile when the Lyapunov stability-based path-following algorithm was applied to it. In summary, the terminal velocity achieved in this research is sufficient for maneuvering inside the stomach organ. The results show that the MCE concept could be used for detecting and diagnosing abnormalities in the digestive system.

國內研討會：

- 105 年度「醫學工程研討會」(提供會員 3 輔助學分)
  活動地點：彰化基督教醫院第二醫療大樓 11F 連瑪玉學術講堂
  會議時間：2016/04/22
  http://www.nhca.org.tw/e/

- 醫療器材上市後管理通報教育推廣(提供會員 3 輔助學分)
  地點：衛服部花蓮醫院
  會議時間：2016/04/29

- 2016 國際組織工程與再生醫學亞太會議 (Termis-AP 2016)
  地點：福容大飯店 淡水漁人碼頭
  會議時間：2016/09/02~06
  網址：http://elitepco.a-team.com.tw/

- 第 11 屆國際糖尿病聯盟西太平洋區糖尿病會議暨第 8 屆亞洲糖尿病研究協會會議
  地點：台北國際會議中心
  會議時間：2016/10/27~30
  網址：http://www.idfwpr2016.org/edm/edm_jan.html

國際研討會：

- 2016 Global Conference on Biomedical Engineering (GCBME 2016)
  National Yang-Ming University, Taipei, Taiwan
  August 17-19, 2016.
  http://bme.ym.edu.tw/GCBME2016/Home.html

- EMedic Global 2016 - Engineering Medical Innovation Global Competition
  The Chinese University of Hong Kong & Hong Kong Science Park
  August 18- 20, 2016.
  http://www.emedicglobal.org/

- BME-HUST 2016 International Conference on Biomedical Engineering
  Hanoi University of Science and Technology (HUST), Hanoi, Vietnam.
  October 5- 6, 2016.
  http://bme-hust.org/

- The International Conference on Biomedical Engineering (2016 ICBME)
  National University of Singapore University Town, Singapore.
  December 7 – 10, 2016.
  http://www.icbme.org/