인 사 말

학 회 장

초대의 글

화사한 봄날을 채 만끽하기도 전에 어느덧 여름이 성큼 다가오는 것을 느끼게 되는 5월입니다.

제 50회 대한의용생체공학회 춘계학술대회에 참석해 주신 회원 여러분들을 환영합니다.

이번 학술대회는 "Breaking Walls between Medical Problems and Engineering Solutions" 라는 주제로 개최하게 되었습니다. 연구를 위한 연구를 넘어 국민 건강과 삶의 질 향상을 위해 가시적인 혜택을 줄 수 있는 의공학적 결과물을 산출하기 위해서는 공학계, 산업계, 의학계가 서로 긴밀하게 협력할 수 있는 장이 필요합니다. 2015년은 우리 학회가 대한의학회의 연관학회로 함께하는 첫해이기도 합니다. 대학-연구소-산업계-병원이 함께 어우러지며 필요한 학문적, 기술적, 임상적 아쉬움을 공유하며 함께 해결하기 위한 소중한 목적지향적 융합의 장이 되기를 기대합니다

의료기기 산업은 의료현장에서 필요한 unmet need를 해결하기 위하여 BT, IT, NT 등 원천기술들이 융합된 첨단 기술산업으로 국가 신성장 동력을 위한 핵심분야로 인정받고 있습니다. 이러한 의료기기 산업 발전에 발맞추어 최근에는 첨단 의료기기 개발을 지원하기 위한 종합적인 인프라로서 첨단의료기기개발 지원센터가 설립되었습니다. 지금까지 이러한 국내 의료기기 산업 발전과 인프라 구축에 우리 학회 및 학회원이 중추적인 역할을 해왔음은 의심할 여지가 없습니다. 이에 그동안 학회를 이끌어 주셨던 원로 교수님들과 회원 여러분들께 다시한번 감사를 드립니다.

보건의료산업과 융합기술의 중요성이 그 어느때 보다 강조되고 있습니다. 특히 보건의료 분야 중 가장 높은 세계적 경쟁력을 갖고 있는 의공학 분야는 국가 헬스산업의 글로벌화를 견인해 줄 선도적 핵심 분야입니다. 다양한 분야의 공학과 의학의 벽을 허물고 진정으로 함께 어우러지며 세계적인 융합학문의 터전이 만들어 질 수 있도록 저희 임원진들은 더욱 노력하겠습니다. .

이번 학술대회 준비를 위해 애써 주신 대구 첨단의료기기개발지원센터 센터장 및 직원 여러분 그리고 학회 임원진께 진심으로 감사의 말씀을 드립니다.

아울러 회원 여러분들의 많은 관심과 지속적인 사랑을 부탁드립니다.

감사합니다.

2015년 5월

대한의용생체공학회 제50회 춘계학술대회 회 장 **송 시 영**

인 사 말

조직위원장

2015년도 춘계학술대회를 맞이하여

저희 대구경북첨단의료산업진흥재단은 2013년도 11월에 정부의 핵심연구시설인 신약개발지원센터, 첨단의료기기개발지원센터, 실험동물센터, 임상시험신약생산센터의 준공식을 시작으로 작년부터 기업과의 공동연구개발지원사업을 본격적으로 진행하고 있습니다.

이러한 시점에서 대한민국 의료기기 기술개발과 인력양성의 중추적인 역할을 수행하고 있는 대한의용생체공학회의 제50회 춘계학술대회를 저희 재단에서 개최하게 된 것을 무한한 영광으로 생각합니다.

잘 아시는바와 같이 첨단의료복합단지조성사업은 대한민국 미래 먹거리를 책임질 사업으로 신약, 의료기기 등의 첨단제품 개발에 필요한 글로벌 수준의 종합적 인프라를 활용하여 성공적인 제품화를 지원하는데 그 목적이 있습니다.

특히, 저희 대구경북첨단의료복합단지는 우수한 인력의 지속적인 유치와 첨단의 장비와 설비를 구축하고 있으며, 이를 기반으로 차별화된 기업지원을 통해 스타기업이 육성 될 수 있도록 최선을 다하고 있습니다.

앞으로도 저희 재단은 대한민국 의료산업 발전을 위해서 노력하겠습니다. 또한 대한민국 의료기기산업의 기술적 발전에 중추적 역할을 수행하고 있는 대한의용생체공학회의 발전을 위해서도 지속적인 관심과 지원을 이끼지 않도록 하겠습니다.

이번 제50회 춘계학술대회를 위해서 저희 재단을 방문하여 주신 많은 분들의 학술적 교류와 건승을 기원하며, 이번 학술대회의 성공적 개최를 위해서 물심양면으로 뒷받침하여주신 이재태 이사장님 이하 재단 구성원들과 학회의 송시영 회장님 이하 사무국 관계자분들, 그리고 대구시 권영진 시장님 이하 시 관계자분들에게 깊은 감사의 말씀을 드립니다.

또한 이번 학술대회를 위해서 기조연설을 수락하여 주신 포항공과대학교의 김용민 총장님과 지역인근에서 큰 힘을 보태어 주신 의용생체공학 관련 교수님들께도 깊은 감사의 말씀을 드립니다.

감사합니다.

2015년 5월

대한의용생체공학회 제50회 춘계학술대회 조직위원장 **이 상 일**

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◉ 일반연제 1, 2 ◉

Biomedical Optics	김범주
Medical Imaging	김세웅, 김준형
Medical Nano and Microtechnology	임남빈
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Biomedical Engineering Education and Career	안형준
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직 책	성 명	소 속	직 책	성 명	소 속
위 원	남윤기	KAIST	위 원	임도형	세종대학교
위 원	송병섭	대구대학교 재활공학과	위 원	임창환	한양대학교
위 원	신정욱	인제대학교 의용공학과	위 원	정동근	동아대 의과대학
위 원	엄광문	건국대학교 의공학부	위 원	한동근	한국과학기술연구원 바이오소재연구센터

2015년도 대한의용생체공학회 춘계학술대회 프로그램

The Korean Society of Medical & Biological Engineering

5월 8일 (금)

시간/장소	대강당	국제회의실	3층 301호	3층 로비
10:00~12:00	Tutorial 1: 대한 Endourology 학회 강좌 의공학자가 알아야 할 필수 생리학 강좌 강사: 이성헌(전남의대), 문흥상(한양의대)	Tutorial 2: 뇌공학, 신경공학 연구를 위한 기초 신경해부학 강좌 강사: 정용(KAIST)	Tutorial 3: National Instrument Tutorial	
12:00~13:20	점심식사			
13:20~13:40	개회식 사회: 구성욱(연세의대)	(중계) 개회식		
13:40~14:40	기조강연: 김용민 (Postech 총장) 좌장: 김동현(연세대)	(중계) 기조강연		
14:40~15:10	Tea break			
15:10~16:10	심포지엄 1 Breaking Walls by Clinicians 좌장: 구성욱(연세의대)	(범부처 특별 세션) 의료기기 R&BD 전략 및 산업육성 방안 좌장: 서수원 (대구경북첨단의료산업진흥재단 첨단의료기기개발지원센터 개발부장)	(식약처 특별 세션) 의료기기 규제과학 및 연구개발 현황 (Regulatory Science and R&D Overview) 좌장: 김혁주(식품의약품안전평가원 의료기기연구과장)	
16:10~16:30	심포지엄 2 Breaking Walls by Engineers 좌장: 변경민 (경희대)			
16:50~17:10			의료기기 개발에서 꼭 필요한 측정 불확도와 소급성 좌장: 안원식(경희대)	
17:10~18:10	의료기기 전문기업 회사 설명회 좌장: 김성민(동국대)	학부생 논문경연 좌장: 유선국(연세대)		
17:10~18:10	만찬			포스터 1 학부생 포스터

5월 9일 (토)

시간/장소	대강당	국제회의실	3층 301호	3층 로비
09:30~10:30				포스터 2
10:30~11:50	일반연제 1: Biomedical Optics, Medical Imaging, Nano/Microtechnology, u-health, e-Health, m-Health 좌장: 유홍기(한양대), 유형석(울산대)	일반연제 2: Neural Engineering, Respiratory Engineering, Tissue Engineering and Biomaterials 좌장: 최성용(경희대), 전상범(이화여대)	의학자를 위한 의료용 센서 첫걸음 강사: 천홍구(고려대)	
11:50~13:20	식사 및 센터 투어(별도 공지)			
13:20~14:40	신진연구자 세션 좌장: 장동표(한양대), 박중열(중앙대)	의사, 의공학자를 위한 의료기기 ISO 규격 좌장: 안원식(경희대)	포스터 3	
14:40~15:00	폐회식 사회: 임창환(한양대)			

2015년도 대한의용생체공학회 춘계학술대회 안내

The Korean Society of Medical & Biological Engineering

◉ **행 사 명:** 2015년도 대한의용생체공학회 춘계학술대회

◉ **개최일정:** 2015. 5. 8(금)~9(토)

◉ **개최장소:** 대구경북첨단의료산업진흥재단 커뮤니케이션센터

◉ **찾아오시는 길**

1. 자가용

· 동대구 IC → 동대구 IC에서 '영천, 안심'방면으로 우측방향 → 화랑로를 따라 3.29km 이동 → 반야월네거리(좌회전) → 신서혁신지구 통과 후 우측방향 → 첨단의료복합단지내 대구경북첨단의료산업진흥재단 4층

· 수성IC(20분 정도 소요) : 수성 IC → '대구국제공항, 경산' 방면으로 우측방향 →월드컵삼거리(좌회전) → 연호네거리(우회전) → 범안로 → 율하역삼거리(우회전) → 반야월네거리(좌회전) → 신서혁신지구 통과 후 우측방향 → 첨단의료복합단지 내 대구경북첨단의료산업진흥재단 4층

· 경산IC(30분 정도 소요) : 경산IC → 경산방면으로 우측방향 → 대학로 → 경산네거리(우회전) → 반야월네거리 → 신서혁신지구 통과 후 우측방향 → 첨단의료복합단지 내 대구경북첨단의료산업진흥재단 4층

2. 버스·지하철

· 지하철 : 1호선 안심역 1번출구, 도보 10분정도 소요

· 버스 : 818, 508, 518, 708, 808, 849-1 도보 10분정도 소요

3. 기차·고속버스

· 동대구역

지하철(20분정도 소요) : 1호선 동대구역 → 안심역

· 동대구고속터미널

지하철(20분정도 소요) : 1호선 동대구역 → 안심역

· 동부정류장

버스(30분정도 소요) : 508번, 518번 안심역 하차 후 도보 10분정도 소요

· 대구공항

버스(40분정도 소요) : 719번 → 대구 1호선 해안역 → 안심역 하차

401번 → 대구 1호선 아양교역 → 안심역 하차
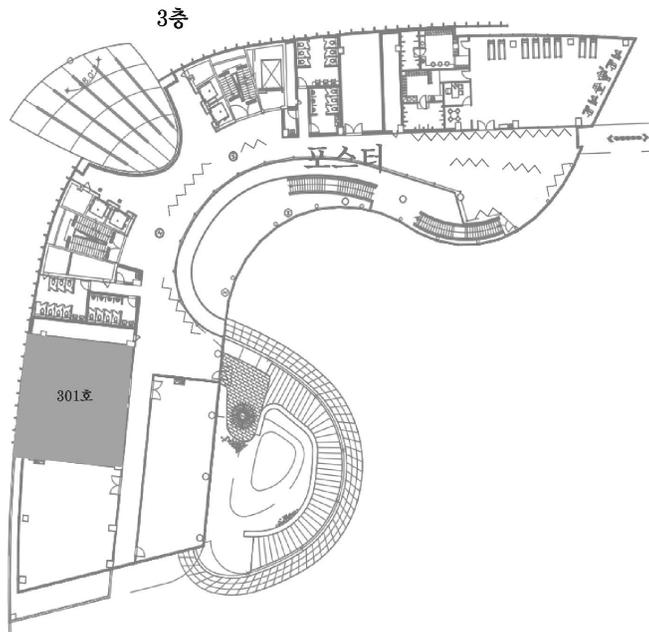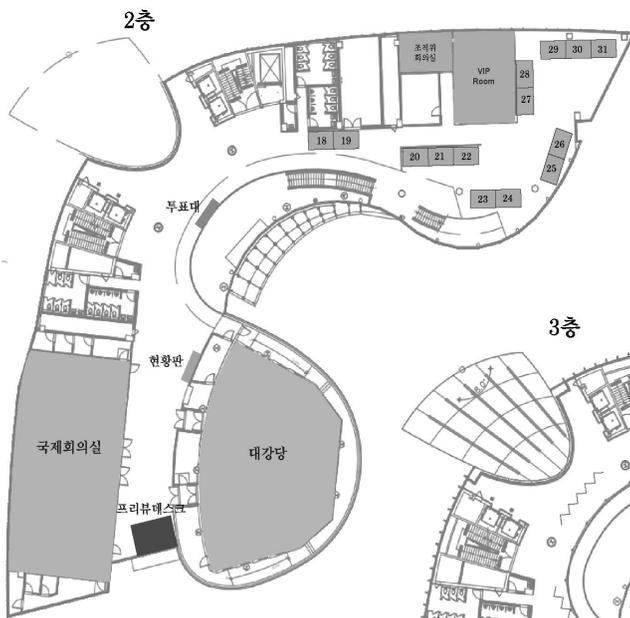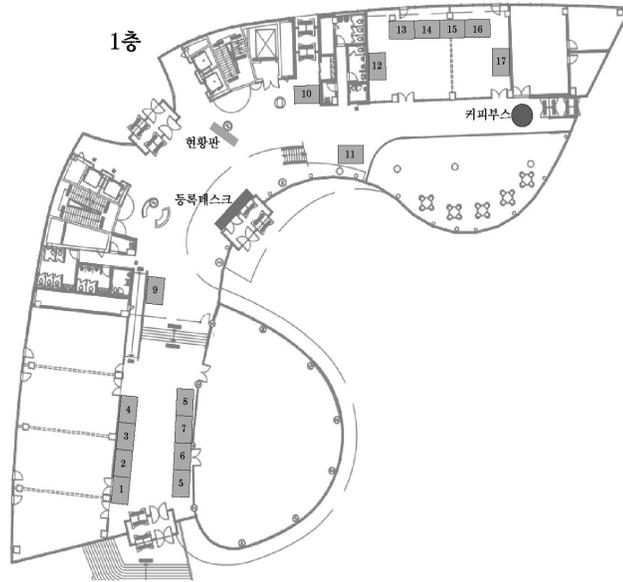
◉ 참가비 납부방법

학술대회 등록비 납부방법

2015 춘계	사 전	당 일
일 반	10 만원	12 만원
학 생	5 만원	6 만원
비회원 일반	11 만원	14 만원
비회원 학생	7 만원	8 만원
학부생(참관)	2 만원	2 만원

* 학술대회 논문발표자는 반드시 학회 회원으로서 연회비 납부와 사전등록비를 각각 별도의 계좌번호 입금처리를 하여 주셔야만 하오니, 이점 착오 없으시길 바랍니다.
* 사전등록비 납부방법: 국민은행, 계좌번호 031-01-0420-215 (예금주: 대한의용생체공학회)
* 연회비 납부방법: 국민은행, 계좌번호 031-25-0006-795 (예금주: 대한의용생체공학회)

◉ **평면도**

1층

13 14 15 16
12
10 17
커피부스 ●
현황판
11
등록데스크
9
4 8
3 7
2 6
1 5

2층

조직위
회의실
VIP
Room
29 30 31
28
27
18 19
20 21 22
26
25
23 24
투표대
현황판
국제회의실
대강당
프리뷰데스크

3층

포스터
301호

기조강연

좌장 : 김동현 교수 (연세대학교 전기전자공학부)

Creating a 21st−century healthcare system
via engineering innovations

김용민 총장 (포항공과대학교)

기조강연

Creating a 21St-century healthcare system via engineering innovations

이름: 김용민
직위: 총장
소속: 포항공과대학교

Abstract

Research-oriented universities play a key role in vibrant entrepreneurial ecosystems. In addition to producing future global leaders in our students, universities develop novel innovations, remarkable discoveries and breakthrough technologies by working on high-risk research and making what people believe impossible possible. Although many pioneering discoveries are being made and new exciting technologies are being developed in academia, even the most promising technologies face numerous obstacles in technology commercialization, particularly in healthcare. They typically languish and die in the valley of death, frustrating the researchers, administrators, and angel investors/venture capitalists alike.

Translational research from lab bench to the marketplace where products and services are provided and consumed is far more difficult and time-consuming than many people estimate or are willing to tolerate. For the benefit of humanity, on the other hand, our mission points us to incessantly making engineering innovations with creativity, collaboration and perseverance so that a better healthcare system for prevention, diagnosis, therapy and management can be developed and deployed although the problems look daunting and impossible. To make the (seemingly) impossible possible takes courage, confidence and competence with partnership, patience and determination. Also, we have to get out from our comfortable silo and break down the tall walls between researchers, laboratories, departments/disciplines and institutions. In this presentation, I will share my experiences and opinions on the obstacles and formula of success (or failure) in academic research and technology commercialization, improving the quality of healthcare.

Brief Biosketch

Dr. Yongmin Kim received his BS degree in electronics engineering from Seoul National University in 1975, and MS and Ph.D. degrees in electrical engineering from University of Wisconsin in 1979 and 1982, respectively. From 1982 to 2011, he was Professor of Bioengineering, Professor of Electrical Engineering, and Adjunct Professor of Radiology and Computer Science and Engineering at the University of Washington in Seattle. From 1999 to 2007, he was Professor and Chair of Bioengineering. From 2004 to 2007, he was the Hunter and Dorothy Simpson Endowed Chair in Bioengineering. In 2011, he came back to Korea to become the President of Pohang University of Science and Technology (POSTECH).

His research interests include imaging and computing, ultrasound systems, distributed diagnosis and home healthcare, and computer architecture. He has supervised many graduate students, leading to ~40 Ph.D. and ~100 Masters degrees. Dr. Kim and his research group have made 85 inventions that have led to ~75 patents, transferred the invented technologies to industry with 28 licenses, and helped commercialization of these technologies. He has more than 450 research publications. He received the 2003 Ho-Am Prize in Engineering and the Distinguished Achievement Award from University of Wisconsin in 2005. He received the Early Career Achievement Award, the Distinguished Service Award and the William J. Morlock Award from IEEE/EMBS in 1988, 2010 and 2011, respectively. In 2012, he received the Inventor of the Year Award from the University of Washington. He was President of IEEE/EMBS in 2005 and 2006. Dr. Kim is a Fellow of IEEE, American Institute for Medical and Biological Engineering, and International Academy for Medical and Biological Engineering.

Symposium I
Breaking Walls by Clinicians

좌장 : 구성옥 교수 (연세대학교 의과대학)

의료기기 개발에 있어 산업화 과정의 국내 현실

송시영 교수 (연세대학교 의과대학 소화기내과)

의료기기 개발에 공학자 참여에 대한 의학자의 입장

김윤년 교수 (계명대학교 동산의료원 심장내과)

심혈관 동맥경화반 정밀 영상법 개발 경험

김진원 교수 (고려대학교 의과대학 구로병원 심혈관센터)

Symposium I

의료기기 개발에 있어 산업화 과정의 국내 현실

이름: 송시영
직위: 교수
소속: 연세대학교 의과대학 소화기내과

　이제 세계 어디에서나 우리의 자동차, TV, 핸드폰을 접하게 되면서 대한민국 국민으로서 커다란 자부심을 느끼게 된다. 그러나 의학, 의료산업 관련 세계 학회나 심포지움을 참가하며 신약, 의료기기, 의료서비스 산업체의 전시장을 볼 때에는 앞서의 산업에서 느낄 수 있었던 자긍심은 전혀 가질수가 없다. 간간히 10여년 전부터 진출하여 꺼질듯 작은 불꽃을 태우고 있는 년 매출 100억 미만의 몇몇 국내 중소기업들의 간판이 자그마한 감동과 아쉬움을 줄 뿐이다. Cell, Nature, Science 와 같은 최고의 학술지에 국내 논문이 증가하고 있지만 이런 기초연구들이 토대가 되어 융합된 응용학문 발전과 산업화로 이어지며 세계 시장 속에서 파급효과를 기대하는 것은 시기상조일 지도 모른다. 그러나 의료산업은 강한 기초연구를 통한 기술력도 중요하지만 기술력만으로 성공이 보장되지는 않는다. 의료현장의 한계를 직시하고, 해결하기 위한 아이디어를 창출하고, 산업구조와 생태계를 이해하며, 국내가 아닌 세계 시장속에서의 생존을 위한 목적지향적 전략을 수립하고, 차별화를 창조하기 위한 지속적인 융합 연구개발에 대한 이해가 필요하다. 의료산업에서 생존을 위해 요구되는 생태계에 대한 이해가 아직도 부족한 현실속에서 국가 의료산업 활성화 역시 시기상조일지도 모른다.

　우리의 미래가 바이오헬스 산업에 있다는 점을 부인할 사람은 없으며, 이미 앞서있는 선진국들조차 더욱 헬스케어 산업의 주도권을 잡기 위해 박차를 가하고 있다. 그러나 우리는 그동안 단지 rule follower 였을 뿐이였다는 자책감과 함께, 선진국에서 만든 제품을 그들이 만든 규범과 가이드라인 하에 사용해야 했으며, 그들의 제품을 우리 환자에게 시험하고 적용하며 우수한 진료기술을 가진 의료진으로서의 자부심은 얻을 수 있었으나 rule creator 로서의 역할은 해오지 못했다. 의료산업의 발전이 바로 의학의 발전이며 의료산업의 세계화 성공이 바로 우리나라 의학과 관련 기초학문들의 세계화 성공이다. 미래 의료인 양성을 위한 교육과 환자를 위한 진료 공여자 역할을 넘어서 새로운 의술을 창조하는 연구개발자와 이를 통해 국가 의료산업을 주도할 동반자 역할을 담당하기 위한 커다란 변혁이 필요하다.

　의료산업은 전자, 기계 산업 등의 일반적인 산업생태계와는 분명한 차이가 있으며, 이에 대한 철저한 이해 없이는 성공이 어렵다. 바이오헬스 산업은 생산자, 수요자(환자), 평가자(의료인)가 각기 다르며, 안전성과 유효성이 엄격한 기준하에 관리되고 객관적으로 증명되어야만 한다. 마음에 들면 소비자가 자유로이 구매할 수 있는 일반제품과는 차이가 있다. 시장의 성공적인 진입 후에도 보수적인 세계 의료현장의 객관적인 설득을 위해 학문적 네트워크의 구축과 이를 통한 개발 후 지속적인 연구는 산업화 성공의 핵심이다. 또한 국가별 인허가 규정과 보험정책에 의해서 진입장벽이 매우 높은 산업이다.

　우리의 여건상 의료산업은 작은 내수시장에서의 성장을 기반으로 한 글로벌 도약을 기대하기는 매우 어렵다. 거대 시장과 잠재적 기술력을 갖고 있는 중국과 인도의 전략과 우리의 전략은 분명히 차별화되어야 한다. 작지만 강한 나라 스위스, 이스라엘, 싱가포르의 성공 모델을 감안하여 후발주자로서 의료산업 성공을 유도하기 위한 제도, 시스템, 기술력에 있어서 차별화된 전략 수립과 경쟁력 확보는 필수 요건이다. 이스라엘은 바이오헬스에 정부지원금의 30%를

투자하고 있으며, 아무리 좋은 아이디어라도 경제성과 수출 가능성에 근거한 평가기준에 적합하지 않으면 지원이 어렵다. 의료산업화는 강한 기초연구도 중요하지만, 의료현장에서 무엇이 필요하며 이를 해결하기 위한 기술이 무엇이고, 진입장벽을 넘어 상용화까지의 전주기적 산업화 성공을 유도하기 위해 필요한 생태계가 무엇인지를 인식한 접근이 필요한 것이다.

의료산업의 성공을 위해서는 연구개발 결과물이 궁극적으로 사용될 의료현장의 목소리를 상시 담을 수 있는 목적지향적인 융합의 장을 마련해야 하나, 취약한 산업체와 다양한 기술들간의 진정성 있는 이해관계 조절이 결코 쉽지 않다. 정보기술(IT), 바이오기술(BT), 나노기술(NT) 등의 원천기술이 실제 인체에 적용시키기 위한 응용기술인 헬스케어 기술(HT; Health Technology) 과 융합되어 공동의 목표를 위해 함께 연구개발을 수행할 수 있어야 한다. 그러나 아직 우리나라는 HT 를 독립된 기술로 인정받지 못하고 있다. 질병을 가진 환자에게 절실하게 필요한 요소를 발굴하기 위한 아이디어도, 시장성 판단의 의료적 전문성도, 제품의 최종 수요자도, 보수적인 의료시장의 국제 공략을 위한 학문적 근거 창출도, 각 국가별 진입을 위한 임상시험의 디자인도 모두 의료현장에서 나온다는 점을 인식한 병-산-학-연의 중개연구를 위한 융합 생태계가 시급히 구축되어야만 한다.

연구개발 초기단계에서 산업화의 성공 가능성을 판단하기는 매우 어려우며, 특히 연구자에 의한 기술적 판단만으로는 오류를 범할 가능성이 매우 높다. 더우기 의료산업은 개발단계에서 제품화 까지 긴 시간이 소요되며, 의료기기는 최소 5-8년, 신약개발은 10-18년이 소요된다는 점은 성공가능성 판단이 현재의 기술력에 대한 판단이 아닌 미래의 연구개발 산업 생태계 변화를 포괄적으로 감안한 정교한 예측이 필요하다. 체계적인 정보 확보, 정교한 세계 동향 분석과 함께 산업체, 의료계, 연구자, 투자가로 구성된 전문가 그룹이 미래 의료현장의 니드와 트랜드 변화를 감안한 판단주체가 되어야 하나 국내 여건은 전혀 그렇지 못하며 이를 판단할 전문가도 부족하다. 이스라엘의 국가연구비 투자를 결정하는 산업정책관과 같은 역할을 할 수 있는 전문가의 조속한 양성과 의료산업 성공 가능성을 높이기 위하여 현재의 국가연구비 투자 결정 과정의 문젯점을 극복하고 중장기적인 안목을 가진 범부처적인 개선 노력이 필요하다.

우리나라 2010년 GDP 대비 국가 총 연구개발비 비중은 세계 3위, 규모는 세계 7위이며, 투자 집약도 및 연평균 증가율도 OECD 국가 중 상위권을 유지하고 있다. 이중 전기전자, 정보통신, 기계 분야는 각각 10조, 8조, 6조 이상의 연구개발 투자가 이루어지고 있으며, 이중 기업 투자비율은 80%를 상회하는데 반해, 보건의료 분야는 1조 6천억원에 불과하고 기업 투자비율은 38%에 불과하다(표 1).

표 1. 분야별, 주체별 연구개발 투자 현황 (2010년)

(단위: 억원, %)

	보건의료		전기전자		정보통신		기계		기타		전체	
	금액	비중	금액	비중	금액	비중	금액	비중	금액	비중	금액	비중
연구기관	3,071	18.2%	6,470	5.9%	8,797	10.5%	8,974	13.0%	35,749	22.4%	63,061	14.4%
대학	7,346	43.6%	4,086	3.7%	3,080	3.7%	3,692	5.4%	29,251	18.3%	47,455	10.8%
기업체	6,429	**38.2%**	98,836	**90.4%**	71,675	**85.8%**	56,225	**81.6%**	94,867	**59.3%**	328,032	**74.8%**
합계	**16,847**	100%	109,392	100%	83,552	100%	68,890	100%	159,867	100%	438,548	100%

이는 보건의료 분야의 연구개발 투자 총액이 전기전자, 정보통신, 기계 분야에 비해 턱없이 적다는 점도 시사하지만, 영세한 기업들의 미미한 투자에 따른 한계성과 함께, 우리나라 헬스케어 연구가 대부분 국가연구비에 의존하고 있으며, 투자의 방향성 결정이 기업의 눈으로 본 판단에 의해 유도되기 보다는 연구자와 각 부처의 눈으로 본 결정에 따라 좌우될 가능성이 높음을 의미한다. 산업화 최종 단계까지를 감안한 목적지향적 투자, 투자의 성공과 실패를 고려한 포트포리오 설정, 보유한 기술력의 객관적인 평가와 투자대비 효율성을 고려한 결정은 기업의 역할이다. 그러나 기업의 역량이 미미한 현 시점에서는, 산업화의 성공 여부 판단은 생산자인 기업과 수요자인 의료현장의 목소리가 함께

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반영되고 관련 연구개발 분야들의 기술력이 조화롭게 반영된 목소리가 어우러져서 객관적이고도 전략적인 국가지원 정책 수립이 절실히 필요하다.

연구개발은 국가지원에만 의존할 수 없다. 산업화 성공의 꿈을 공유할 수 있는 역량과 비전을 가진 기업의 육성과 이들 기업들이 산학연병의 공동 연구개발을 통해 의료산업화 성공 가능성을 높힐 수 있는 생태계 조성과 제도적 지원이 필요하다. 최근 우리나라 기업들의 바이오 산업 진출이 두드러지고 있다. 많은 국가적 투자에도 불구하고 글로벌 블록버스터 신약 하나 도출되지 않는 이유가 산업화를 가속시킬 수 있는 기업의 부재 때문이라는 다소 조급함에 의한 접근도 필요하지만, 호수 속에서 다양한 종류의 치어들이 성어로 클 수 있는 환경 조성과 같이 기초 및 중개 연구 저변을 국가와 기업이 함께 키울 수 있도록 생태계를 조성할 의무가 있다. 잡힌 물고기를 요리하여 상품으로 만드는 것은 기업의 역량에 달려있지만 큰 호수 속 물고기의 성장을 몇몇 기업이 모두 유도할 수도 없다. 치어 때부터 관심을 갖고 키우면 좋은 요리를 만들 수 있는 성어로 성장할 수 있다는 가능성을 믿고 중장기적인 인프라 확충을 위한 국가의 역할과 함께 기업은 이 속에서 보다 가치있는 물고기를 잡을 수 있는 생태계 조성이 궁극적으로 기업의 이익이 될 수 있음을 인지하고 국가와 함께 산학연병 네트워크 생태계를 만들어야 한다. 그러나 아직 국내 산업체는 다국적 기업과는 달리 생태계 조성을 위한 초기 투자에는 너무나 인색하다.

다국적기업 S 제약사는 년간 9조원의 연구개발 투자와, 15,000명의 연구인력이 60여개의 프로젝트를 수행하면서도 매년 신약으로 부상하는 후보는 수개에 불과하며 후보가 바로 산업화 성공으로 이어지지도 않는다. 2008-2010년 사이, 세계적으로 55개 신약이 임상 3상 단계까지 가서도 상용화에 실패했다. 이전 3년 동안에 비해 2배 이상의 실패율이며, 기존제품 대비 경쟁력 확보가 점차 어렵고, 경기 침체, 허가 관련 규제 강화, 경제성 평가 대비 국가별 수가책정과도 관련이 있는 어려운 여건속에 있다. 우리는 바이오헬스 연구를 위해 년간 1조 6천억원의 국가지원이 되고있으며, 이중 신약개발 관련 연구비는 4000 억 미만이다. 상기 다국적기업의 연구개발 현황을 고려할 때 우리는 분명 성공을 위한 특단의 전략이 필요하다. 선진국 모델을 따라만 가서는 성공하기 어렵다는 위기의식 속에 우리의 강점과 한계를 인지한 새로운 전략이 수립되어야 한다.

세계 최고(World Best), 세계 최초(World First), 틈새 시장(Niche Market) 이란 서로 다른 그림 속에서 우리의 강점과 한계를 인지한 국가적인 의료산업화 포트폴리오가 구축되어야 하고 이 속에서 각자의 맡은바 역량을 다해 수익을 창출할 수 있는 성공모델을 구현하여 우리의 자심감을 하루 속히 확보해야 한다. 세계 최고는 대기업의 주된 역할일 수 있으며, 세계 최초는 연구자가 주된 역할을 할 수 있으며, 틈새시장은 의료인, 산업계, 연구자의 공동 작품이 더 중요한 생태계일 수 있다(표 2).

유형	특성
World Best	시장지배적 기업이 있고 Red Ocean Market 이지만, 기술혁신을 통한 높은 수준의 성장점유율 달성이 가능한 분야에 선택과 집중
World First	미래사회 수요 분석으로부터 전세계가 경쟁적으로 개발하고 있거나 창의적 아이디어에 기반한 신개념 의료분야 개발 사업에 투자
Niche Market	기존 시장의 틈새 시장을 공략할 수 있는 조기성과 창출형 분야에 공략

2006년도 미국 NCI에서는 중개연구의 정의로 "실험실, 임상현장 또는 집단(population)의 연구로 부터 도출된 과학적 발견을 임상 또는 집단에 적용 가능한 개발로 이어질 수 있도록 하여 실질적인 질병 발생, 이환율, 사망율을 감소시킴으로서 인류 건강을 증진시키기 위한 연구" 라고 정의하였다. 쉽게 표현하여 중개연구란 수세기 동안 지속되어 왔던 기초연구와 임상연구 사이의 벽을 허물고 의료현장에 적용가능한 실질적인 결과물을 도출시키자는 뜻이다.

중개연구란 용어는 연구개발이 실제 환자에 적용되기 까지에는 많은 시간과 경비가 소요된다는 의료산업의 특성 속에서, 신속하고 효율적인 연구개발을 유도하기 위한 궁여지책에서 출발했다고도 볼 수 있다. 최근 선진국은 단순한 학문적 융합 개념에 머물고 있는 중개연구의 한계를 인지하고 연구개발에서 산업화 이행 과정에서의 실질적인 고비를 극복하기 위한 자문 및 투자(GAP funding)를 포함한 새로운 노력이 시도되고 있다. 그러나 우리는 아직 중개연구의 틀도 제대로 구축하지 못하고 있는 현실속에서 미래 먹거리라 불리우는 의료산업 성공을 위해 선진국과 경쟁하기 위해서는 과감한 결단이 필요하다.

우리는 어쩌면 지금 중개연구란 용어를 각자의 입장에 따라 서로 다른 뜻으로 해석하고 있는지도 모른다. 기초와 임상, IT와 BT가 융합해야 한다고 하지만 그 융합의 목표는 실제 인체에 적용 가능한 실용화 성공과 의료현장에서 필수불가결한 제품으로서 산업화 성공을 거두기 위한 목적지향적 융합이라기 보다는 연구비 확보를 위한 잠정적인 융합의 논리속에 진정성이 감추어지고 있을지도 모른다. .

헬스케어 연구비 지원은 더욱 증가해야만 하나 언제까지 국가가 현재와 같이 대부분을 책임질 수는 없다. 국가연구비는 강한 기초연구 및 의료산업화 인프라 구축에 보다 집중하고, private equity funding 과 같이 국가연구비 외의 헬스케어 관련 연구개발 투자자금을 형성하여, 이 속에서 산업의 눈으로 본 성공여부의 객관적 판단 기준을 적용하여 이에 근거한 산업화 촉진 투자시스템이 국가적으로 절실히 필요하다. PE 자금의 운영이 성공적으로 유도되기 위해서는 정부의 영향력이 철저히 배제되어야 성공을 거둘 수 있다.

미국 및 유럽의 유수한 대학병원들은 진료를 위한 공간의 수배에 달하는 연구공간을 갖고 있다. 그 공간 속에는 공학자, 생명과학자 들이 전공에 따른 장벽도 없이, 기초와 임상이란 장벽도 없이 서로 임상현장의 문젯점을 공유하며 이를 해결하기 위한 공동의 목표를 향해 달려가고 있다. 우리나라의 헬스케어 관련 연구를 하는 많은 기초과학자들은 학위 또는 연수기간 중에 이들 해외 병원 속 연구공간에서 함께 어우러지며 연구를 하는 경우가 빈번하다. 그러나 귀국해서 복귀할 기관은 미국과 같이 병원도 의과대학도 아니요, 공과대학, 이과대학 등의 각자가 속해 있는 서로 다른 학제의 구성원으로 복귀하며 각자의 학제를 대변하는 목소리를 내게된다. 연구비 확보를 위한 한시적인 융합이 있을 뿐이요, 연구비가 소멸되면 다시 남남이 된다. 함께 진행하던 연구를 단기간의 결과에 급급하지 않고 보다 지속적으로 밀어 줄 수 있는 취약한 산업 생태계도 분명 하나의 원인이기도 하다. 우리는 결국 국가 연구비 확보를 위한 철새와 같은 한시적 융합의 존재일 뿐이며, 연구비 확보 가능한 기준조건을 충족한 중견연구자들 간의 융합이 대부분이며 참신한 아이디어를 키워주고 미래를 짊어질 융합형 젊은 의생명과학자를 육성하기 어려운 현실속에 있다. 이런 틀 속에서는 장기적으로 선진국과 경쟁을 할 수 없다. 학제간 벽을 허물 수 있는 근원적인 방안을 모색해야 한다. 최근 점차 활발히 시도되고 있는 겸임교수, 겸무교수 제도만으로는 부족하다. 서로 다른 분야의 연구자들이 동일한 목적하에 물리적으로 섞일 수 있는 연구여건 조성을 위한 지원이 필요하다. 연구과제에 따라 기초학자들의 한시적 병원내 공간 사용을 위한 정부의 지원책도 새로운 접근 방법일 수 있다. 먼 미래를 위해서는 학생 교육에서부터 벽을 허무는 융합 교육이 필요하고 융합형 미래 인재를 양성해야 한다.

병원내에서의 현실도 마찬가지이다. 의과대학생의 교육적 측면에서 교과목 위주로 100여년 전 부터 구분되기 시작한 기초학 분야들도 지금은 학생 교육이외의 연구측면에서는 교실의 구분이 소실되어 온지 오래다. 같은 의료현장 속에서 기초와 임상이 어우러지며 함께 하는 융합도 아직은 충분치 않다. 이제 우리는 변해야 한다. 병원에서 HT 관련 연구자들이 함께 몸과 마음을 부딪히며 공동의 목적을 같고 한 목소리를 낼 수 있는 환경을 신속히 만들어야 하며 이 속에서 생명과학, 생명공학자와 함께 할 수 있는 보다 큰 융합의 틀을 만들고 유지할 수 있도록 국가와 기업의 적극적인 지원이 절실히 필요하다. 연구중심병원은 이와 같은 생태계 조성을 위한 자그마한 첫 출발일 뿐이며 보다 큰 그림이 그려져야만 한다.

HT 연구의 동반자로서 병원이 자리매김 하기 위해서는 기초과학 분야의 연구가 실용화에 적용될 수 있는 강한 원천기술로 발전할 수 있도록, 기업체가 가시화된 실용화 제품을 성공적으로 생산할 수 있도록 열린 협력의 장을 제공해야 한다. 그 어떤 국가보다도 진료의 수월성을 확보하고 있는 국내 병원, 그 어떤 국가보다도 높은 환자의 집중도,

정제된 방대한 의료정보 및 검체, 최고의 우수 인력을 보유하고 있는 병원이 의료산업에 기여하기 위해서는 병원의 노력도 중요하지만 병원에서 얻어가는 정보의 가치를 객관적으로 인정해 주는 공동연구자 및 기업들의 인식의 변화와 보상을 위한 객관적인 지표설정이 절실히 필요하다. 병원에서 도출되는 아이디어를 지적재산권으로 가치화시키고자 하는 변화는 병원의 몫이다.

국내 병원들은 갈수록 열악해지는 의료환경 속에서 생존하기 위해 몸부림치고 있으며, 진료의 우수성 경쟁으로 환자를 유입하기 위한 병원간 전쟁중에 있으며, 해가 갈 수록 병원간의 경쟁은 더욱 심화되고 있다. 대한민국 최고의 인재들이 몰리고 있는 의료현장의 미래 인력이 당면한 수익창출을 위해 진료에만 몰입시킬 수 밖에 없는 현실속에 떠밀려 가고 있으며, 어찌보면 연구개발은 일과시간이 끝난 후 밤늦게 까지 하고 싶은 개인의 취미생활 일지도 모른다. 그러나 너무나 다행스럽게도 불타는 의욕을 잃지 않고 연구에 보람과 흥미를 갖고 열정적으로 매진하는 많은 우수한 인력들이 있다. 선진국과 같이 연구에 투자할 시간, 인력, 공간이 제공될 수 있는 현실적 대안 마련이 중장기적으로 국가 의료산업 성공을 위한 중요한 요소임을 인지하고, 이들에게 더 획기적인 창의성을 발휘할 수 있는 환경조성을 위해 국가적 지원이 필요하다. 이들 인력은 단지 각자의 연구를 위한 연구자로서의 가치만이 아닌 의료산업을 위해 필요한 다양한 전공분야의 연구자, 산업체와의 연결고리로서의 역할을 수행할 소중한 인재들로 키워져야 한다.

의료산업의 활성화를 위해서는 교육기관인 대학도 변화해야 한다. 승진을 위한 최소요건 달성을 위해 연구를 위한 연구에 몰입할 수 밖에 없는 생태계에서부터 산업화 유도 역량을 감안한 새로운 평가기준이 함께 적용되는 시스템이 마련되어야 한다. 대학의 교수업적 평가기준의 하나인 논문 수, impact factor 도 중요하지만 산업화를 촉진시키기 위해서는 보다 강한 기초, 중개연구를 유도하기 위해 직급연한에 쫓기는 논문의 수 보다는 강한 연구결과를 만들기 까지 기다려줄 수 있는 제도도 필요하고, 산업화 가능한 강한 특허군 창출까지도 유도할 수 있는 변화된 새로운 기준의 수용도 고려해야 한다.

우수한 인재들이 몰려있든 병원이 국내의 병원간 진료 전쟁을 넘어서, 병원간 국가 연구비 확보를 위한 전쟁을 넘어서, 대한민국의 의료산업 발전과 의학발전은 우리 내부가 아닌 세계속의 전쟁속에서 함께 승리할 수 있어야만 이룰 수 있다는 당위성을 인지한 새로운 접근이 필요하다. 공학, 자연과학 등의 관련 분야는 물론 인문, 사회, 정치, 경영에 이르기 까지 비의료인들과 공감대를 형성하기 위한 리더쉽과 노력도 절실히 필요하다. 어려운 국내 기업의 투자만을 바라보기 보다는 우리들의 강점을 함께하여 다국적 투자를 유도하기 위한 융합의 전략도 필요하다.

최근 보건복지부에서는 새로이 연구중심병원을 지정하였다. 연구중심병원은 단순히 연구비를 지원받기 위한 수단이 아니라 국가 헬스케어 산업화라는 큰 그림을 그리기 위한 밑그림이다. 각 병원의 연구력도 중요하지만 궁극적으로는 병원, 산업체, 기초연구자 간의 네트워크를 구축하여 국가의 글로벌 산업경쟁력을 기르는 허브로서 병원이 역할을 다해야한다. 즉 연구중심병원은 'HT 산업화를 위한 의료현장 중심의 플랫폼 구축사업'이다. 연관 기술들을 병원과 함께 어우러지는 생태계 조성을 위한 허브이며, 그동안의 병원간의 진료 경쟁구도를 넘어서 미래 글로벌 경쟁에서 국가 경쟁력 강화를 위한 네트워크가 되어야 하며, 강한 융합을 위한 초석이 되어야 한다. 한 병원이 인프라를 모두 갖출수도 없고 다른 병원 또는 국내외 산업체의 인프라를 적극 유도할 수 있는 국제경쟁력을 갖춘 연합 허브로서의 역할을 수행하며, 두뇌(인적자원)와 과학 인프라 자원을 끌어들일 수 있어야 한다. 이는 결코 쉬운 일은 아니지만 적어도 몇 몇 병원간이라도 시도해 볼 수 있는 새로운 접근이다.

이는 연구중심병원에 선정된 병원들만의 일은 아니다. 연구중심병원 선정 여부와 무관하게 향후 각 병원에서 갖고 있는 나름의 특화된 역량을 기반으로 관련 기초분야와의 융합의 틀을 구축해야 한다. 또한 진료를 통해 도출되는 다양한 아이디어를 발굴하며, 양산되는 데이터 기반 실용화 전략을 제공 검증하고, 개발된 기술의 산업화 현장으로서, 세계 의료 네트워크 유입 및 전파를 위한 창구 기능을 통한 국내 산업 발전의 중심역할을 해야 한다. 국가도 연구중심병원이 단지 의료인들만의 움직임이란 오해를 넘어서 국가 헬스케어 산업의 총체적 틀 속에서 그 역할을 조명해야 한다. 글로벌 바이오헬스 산업 강국으로 도약하기 위한 새로운 파라다임 구축을 위해 병원의 역할을 보는 눈이 필요하다. IT 및 자동차 산업을 경험으로 우리의 무궁한 잠재력을 어떻게 의료산업에 창조적으로 유도할 것 인가에 미래

가 달려있다. 어려운 병원 운영의 현실 속에서 진입시기에 안정적 정착을 위한 제도적 지원이 절실히 필요한 것이다.

우리나라 연구개발 투자는 선진국 수준을 상회하나 생산성은 평균 이하에 머물고 있다. 생산성 극대화를 위한 변화를 모색해야 하는 기로에 서 있으며, 우리의 여건을 감안한 차별화 전략이 필요하다. 바이오헬스 연구개발 투자의 양적 확대는 최우선 과제이다. 그러나 주어진 현실 속에서도 강한 바이오헬스 산업국가로 도약하기 위한 투자 효율성 증진과 질적 향상을 위한 새로운 전략을 마련해야 한다. 우리는 바이오헬스 강국으로 도약할 수 있는 무궁한 잠재력을 갖고 있다.

결론적으로, 첫째 바이오헬스 산업은 융합이다. 병원을 중심으로 기업, 연구기관, 대학, 컨설턴트, 서비스 업체가 함께 모여 공동의 목표하에 부가가치 생산을 위해 강력한 시너지 효과를 내는 네트워크 구축이 필요하다. 학제간, 대학간, 병원간, 부처간의 연구비 확보 경쟁에서 벗어나, 뭉치면 더 큰 수익창출을 도출할 수 있고 이 속에서 공평하게 결과를 나누는 성공모델의 가시화가 필요하다. 이미 다국적 기업은 내적으로는 마케팅, 임상연구, 연구개발 부서의 융합체계를, 외적으로는 세계 전문가 그룹과의 융합 체계를 구축해 가고 있다. 질로서 승부하는 세계 최고의 제품, 아이디어로 승부하는 세계 최초의 제품과 cure(치료) 및 care(관리) 의료현장의 틈새 공략 제품을 개발하고, 대기업, 중견기업, 벤처기업들의 역할 분담을 통한 공존 환경을 만들수 있는 체계를 구축해야 한다.

스위스는 정밀기계공업은 물론 Novartis와 Roche와 같은 거대 다국적 제약사를 갖고 있다. 인구 800만인 자그마한 국가에서 세계 의학을 지배하는 거대한 의료산업을 갖게된 이유가 무엇일까 궁금하지 않을 수 없다. 스위스는 정부 부처의 역할도 뚜렷하지 않고 대통령도 돌아가면서 한다. 국가는 아주 큰 방향성을 제시하고 각 지역의 대학과 병원은 큰 방향성에 부합되는 virtual network를 구성한 후 각자의 일을 수행한다. 그 속에서 모든 결정은 협의를 통해 진행된다. 우리가 따라하기에는 전혀 다른 생태계이지만 어찌보면 오늘날의 novartis와 roche가 있게된 중요한 원천일 수도 있다. 즉 각자의 경쟁력 있는 전문성과 목적지향적 융합과 성공모델을 통한 재투자이다. 필자는 최근 스위스를 방문할 기회가 있었다. Basel 대학의 옆에 위치하면서 10여개의 커다란 연구동들이 즐비하게 늘어서 있는 Novartis campus 속에는 건물 어디에 들어가도 창조와 융합의 이념을 체감할 수 있었다.

둘째, 산업화 성공율이 5% 미만인 국가연구개발과제의 효율성 개선이 필요하다. 이를 위해서는 연구자중심의 기술에 근거한 개발기획에서 부터 산업친화적 개발기획으로의 변화가 필요하며 이를 위해서는 산학연병의 연계가 필수적이다. 연구개발 단계를 부처별 특성에 따라 역할을 분리하여 지원하는 방안에서 탈피하여 글로벌 산업화 관점에서 성공 유도를 위해 화학적으로 섞인 전주기적 통합 관리가 필요하다. 투자 포트폴리오에서도 강한 원천기술 개발을 위한 기초과학 분야의 적극적인 지원과 함께 이와는 철저히 구분되는 의료산업화 성공을 위한 새로운 개념의 차별화된 성공 유도 지원책 구성을 위한 전략이 별도로 있어야 한다.

셋째, 병원도 환자 유치를 위한 경쟁을 넘어, 연구비 확보를 위한 대학간, 학제간 경쟁도 넘어서, 글로벌 바이오헬스 산업 강국으로 도약하기 위한 새로운 패러다임 속에 병원간의 협력의 틀을 구축해야 한다. 국가 HT 산업의 가시화된 성공 유도를 위해 서로 함께할 수 있는 방안을 모색하여 우리의 무궁한 잠재력을 어떻게 창조적으로 유도할 것인가를 함께 고민해야 한다. 세계최고의 인재들이 새로운 창조를 통한 의료산업화 성공의 핵심인력이 될 수 있도록 길을 만들어 주어야 하며, 이길은 산업화의 성공만이 아니라 우리 의학과 의료산업에 관련된 모든 학문분야의 세계화에 접근하는 가장 지름길이기도 하다. 우리는 분명 성공할 수 있다

Symposium I

의료기기 개발에 공학자 참여에 대한 의학자의 입장

이름: 김윤년
직위: 교수
소속: 계명대학교 동산의료원 심장내과

Abstract

인간의 수명이 길어지고 특히 건강에 대해 관심이 높아지면서 최근에 더욱더 화두나 세간의 관심이 의료기기에 모이는 것 같다. 의료기기의 특성을 보면 이름에서부터 의료와 공학의 융합임을 알 수 있다. 과학의 두 영역을 잘 알고 융합할 수 있는 조직이나 연구자가 있어야 이러한 일들이 가능할 것이다. 의료기기의 개발에 있어서 의학의 영역에서 공학의 도움이 필요한 것은 창의성이다, 기존에 사용되지 않은 부분이나 지금까지 존재하지 않은 새로운 기기의 개발이다. 의학의 영역의 확대나 발전으로 새로운 의료기기들은 항상 개발되고 있기 때문이다. 다른 하나는 차별성이다. 지금까지 수많은 의료기기들이 개발되어 인간의 생명을 구하였다. 이러한 의료기기들이 갖고 있는 정확성, 편리성, 그리고 경제성을 파악하고 이를 개선하거나 새로운 개념의 의료기기를 개발하여야 의료의 영역에 정착할 수 있을 것이다. 이러한 점들을 파악하는데는 의료 현장에서 현 의료기술의 체험 뿐만 아니라 의료 흐름, 네트워크 그리고 현 상태의 효율성과 경제성을 파악하는 게 중요하다. 따라서 공학을 전공하시는 분들의 실질적 참여가 있어야 실제적으로 의료 현장에 뿌리를 내리는 의료기기를 개발할 수 있겠다.

Brief Biosketch

1984~현재	계명대학교 의과대학 교수
1990~1991	University of Michigan 방문교수
2004~2006	대한순환기학회 연구회장(부정맥연구회)
2007~2012	대한의용생체공학회 지부장(영남지부)
2004~	진료심사평가위원회 심사위원
2006~	정보교류시범사업 모형개발 워킹그룹 부위원장
2006~	보건의료정보화위원회 실무위원
2011~현재	대한심장학회 지회장(대구경북지회)

심혈관 동맥경화반 정밀 영상법 개발 경험

이름: 김진원
직위: 교수
소속: 고려대학교 의과대학 구로병원 심혈관센터

Abstract

Coronary plaque destabilization is a complex, multi-step process and thus, current imaging focusing on plaque morphology and burden has been still limited to accurately predict the risk of plaque rupture. This increasing demand led us to focus on the molecular imaging to look at biological behavior of the atheroma beyond structural information. By targeting different molecular pathways, the molecular imaging is able to better delineate biological characteristics of high-risk plaques. With encouraging previous results and advance in understanding of the biological process regarding high-risk plaques, our group recently developed a novel integrated imaging strategy, high-speed intravascular OCT-NIRF structural-molecular dual-modal imaging. This imaging strategy is highly translatable and could enhance our capabilities to detect high-risk coronary plaques.

Brief Biosketch

Prof. Jin Won Kim, MD, PhD is an interventional cardiologist at Korea University Guro Hospital, who is well-known for his remarkable research performance in translational research as well as medical practice in the field of interventional cardiology. With two years of post-doctoral training as a full-time research fellow in cardiovascular molecular imaging program at Harvard Medical School, Prof Kim is working on novel multimodal imaging and therapeutic approaches to overcome coronary artery disease. Prof. Kim won Astra-Zeneca Research Award in 2014 and Yuhan Medical Research Prize in 2012 for his contribution to the Korean cardiology. With more than 5 years collaboration, profs. Kim and Yoo have worked together in this field.

Symposium II
Breaking Walls by Engineers

좌장 : 변경민 교수 (경희대학교 생체의공학과)

공학자 측에서의 장벽 극복: 인공중이 개발 과정에서
의료진과 함께한 협력 연구의 경험

조진호 교수 (경북대학교 IT대학 전자공학부)

Performance-enhanced surgical devices
by local drug delivery functionality

최영빈 교수 (서울대학교 의과대학 의공학과)

심혈관질환 극복을 위한 의광학-의학 융합연구 경험

유홍기 교수 (한양대학교 공과대학 생체공학과)

Symposium II

공학자 측에서의 장벽 극복; 인공중이(Middle Ear Implant) 개발 과정에서 의료진과 함께한 협력 연구의 경험

이름: 조진호
직위: 교수
소속: 경북대학교 IT대학 전자공학부

Abstract

우리나라는 세계 굴지의 첨단 IT제품을 생산하는 인재들과, 상위 1% 미만의 우수 학생 들이 몰리는 의료계의 인적 자산을 함께 가지고 있지만 의료기기 산업의 열세를 면치 못하고 있는 실정이다. 최근 의료기기산업을 부흥하기 위한 국가적 노력이 이어지고 있으며 기업들의 관심도 어느 때 보다 더 높다. 의료기기 산업의 부흥은 모든 의공학도들의 바램이기도 하다. 그러나 반드시 준비하고 거쳐야 할 단계를 건너 뛰고서는 단시간에 뜻을 이루기가 힘들 것이다. 본 질적으로 의료기기 산업은 의학과 공학의 융합의 산물이기에 지금 우리나라에서는 이 두 분야의 융합이 잘 이루어지 도록 하는 것이 매우 중요한 과제이다. 융합의 촉진을 위해 공학에서 의학으로 노크하는 것과 의학에서 공학의 손을 잡는 것 모두가 필요하다. 본 강의에서는 인공 중이 라는 하나의 아이템 개발을 통하여 짧지 않은 시간 동안 공학자 로서 경험 하였던 내용을 소개 함으로써 우리나라 의료기기 산업발전을 위한 방안을 함께 생각해보기로 한다.

Brief Bioksketch

연자는 1988년 경북대학교 전자공학과에서 박사학위를 취득했고, 1984년부터 경북대학교 전자공학부 전임강사로서 경북대학교병원 의공학과 과장의 보직을 받아 24년간 병원의 의료기 관리와 의공학 연구 업무에 종사하였다. 1998년 경북대학교 의공학연구소의 설립 및 대학원의공학과의 개설, 2000년 경북대 의과대학 내에 의공학교실의 개설하였으 며 현재 경북대 의공학연구소의 소장을 맡고 있다. 2009년 대구시의 첨복유치위원회 위원으로 활동 하였고, 대한의용 생체공학회회장(2012년), 경북대학교 IT대학 초대학장(2010-2011) 등을 역임했다.

Performance-enhanced surgical devices by local drug delivery functionality

이름: 최영빈

직위: 교수

소속: 서울대학교 의과대학 의공학과

Abstract

Medical devices have been drawing much attention in both industry and academia to improve the efficacy and convenience in therapy; however, critical issues, such as low biocompatibility and patients' compliance, have been still unresolved and remained as their unmet clinical needs. In our lab, we pursued to improve the performance of the medical devices in clinical use by allowing local drug delivery functionality. In one instance, we developed a surgical suture enabled with drug delivery to relieve local pain after surgery. The drug-delivery sutures could effectively relieve the pain at the surgical site in a sustained manner during the period of wound healing, also showing biocompatibility and mechanical property comparable to the original surgical suture in clinical use. In another instance, we also developed silicone implants enabled with acute, local drug delivery to reduce fibrosis. With local, sustained release of an inhibitory drug of a major profibrotic cytokine (TGF-ß), the implants exhibited a significant decrease in capsule thickness and collagen density.

Brief Biosketch

2013~현재   의과대학 부교수

2009~2013   서울대학교 의과대학 조교수

2006~2009   Georgia Institute of Technology Postdoctoral fellow

2012~2013   대한의용생체공학회 학술이사

2012~2012   한국생체재료학회 DDS 분과이사

Symposium II

심혈관질환 극복을 위한 의광학–의학 융합연구 경험

이름: 유홍기
직위: 조교수
소속: 한양대학교 전기생체공학부 생체공학전공

Abstract

Multimodality optical imaging technologies enabled comprehensive assessment of biological tissue by providing structural, molecular, and biochemical information. Optical coherence tomography (OCT) and confocal fluorescence microscopy (CFM) are well established optical imaging technologies widely used in biological and medical fields. In this talk, we will present technical advances and applications of several multimodal optical imaging technologies for cardiovascular disease, including 1) intravascular OCT for morphological imaging of arterial wall; 2) multimodal OCT-near infrared fluorescence imaging catheter for comprehensive evaluation of atherosclerotic plaque in vivo; 3) multifunctional confocal fluorescence microscopy that enables high-resolution imaging of macrophage-rich atheromata in vivo. These new imaging technologies could provide new opportunities for investigating cardiovascular disease. Additionally, we will discuss requirements for successful collaboration between engineers and clinicians.

Brief Biosketch

Hongki Yoo is an assistant professor of Biomedical Engineering at Hanyang University. He received his PhD in mechanical engineering from KAIST in 2007. Before joining the Hanyang faculty in 2012, he worked in the field of biomedical optics at Harvard Medical School and Massachusetts General Hospital. His research focuses on developing novel optical methods including confocal microscopy, OCT, fluorescence molecular imaging, intravascular catheter, and endoscopic probes to solve challenging medical problems.

범부처 특별 세션

좌장 : 서수원 (대구경북첨단의료산업진흥재단 첨단의료기기개발지원센터 개발부장)

산업통상자원부의 의료기기산업 R&BD전략
허 영 PD (한국산업기술평가관리원 의료기기 PD)

Introduction to 2015 NRF Medical Device R&D Trend
임혜원 단장 (한국연구재단 국책연구본부 뇌첨단의공학 단장)

국내 의료기기산업 육성을 위한 복지부 · 진흥원 지원방안
박순만 실장 (한국보건산업진흥원)

범부처 특별 세션

산업통상자원부의 의료기기산업 R&BD전략

이름: 　허　영
직위: 　의료기기 PD
소속: 　한국산업기술평가관리원

Abstract

산업통상자원부(산업부)의 의료기기 R&BD전략의 핵심은 기술 위주R&D 지원방식에서 시장위주의 R&D 지원 방식으로 전환 하므로서 R&D 생산성을 크게 높이고자 한다. 과제지원 유형도 정부-민간, 연구주체 별 역할을 고려하여 "원천형"과 "제품형"으로 구분하여 Two Track으로 과제기획을 추진하는데, 제품형은 기업체 주관, 원천형은 출연(연)/대학이 주관하도록 하며, 특히 민간의 창의성 유도 및 도전적 목표 창출을 위해 기술/품목을 지정(개략적 목표, RFP)한 후 공모를 통해 경쟁제안 방식으로도 추진하고 있다. 산업의 성장잠재력 확충을 위해 융합 관련 신규과제 발굴·지원을 강화하고 표준?특허를 연계한 과제 기획과 수행을 적극 지원하고 있다. 특히 FTA로 국내 의료기기시장이 개방되는 향후 3~5년은 국내 의료기기산업 경쟁력확보의 마지막 기회로 종합대책 마련이 시급하다고 판단되어 현장 애로사항을 수시로 파악하고 사전기획을 강화하고 있으며, 특히 전주기 밀착 지원과 사업화를 위한 다양한 지원사업을 통해 의료기기 산업의 생태계 조성을 포함하는 성공적인 R&BD 전략을 매년 수립 하고 있다.

Brief Biosketch

▌학력
1995년	미국 텍사스주립대학교 졸업 (공학박사)
2005년	미국 University of Washington (Seattle) Medical Center 방사선과 연수

▌경력
2011년	IEC-TC 62 전문위원회 위원장(국가기술표준원)
2013년	미래부 국가 30대 중점기술 전략로드맵 의료기기팀장
2013년	의료기기 위원 / 심의위원(식약처)

Introduction to 2015 NRF Medical Device R&D Trend

이름: 임혜원
직위: 연구재단 국책연구본부 뇌첨단의공학 단장
소속: 연구재단

Abstract

The National Research Foundation of Korea (NRF) is a specialized research funding agency, established in 2009. This is the biggest governmental funding agency of Korea which is the merge product of 3 formerly independent funding agencies. NRF supports creative academic research not only in science and technology but also in humanities and social sciences including academic studies, and interdisciplinary academic fields. Division of Brain Research and Medical Platform Technology is under the Directorate for National Research in NRF. Current status of NRF in New Concept Medical Device with respect to project evaluation and management will be discussed in this session. In addition, funding trend and plans of 2015 Medical Device Research will be discussed.

Brief Biosketch

Academic Background

1995	Ph. D.	Dep. of Physiological & Pharmacological Sciences, University of Chicago
1987	M. S.	Dep. of Chemistry, Seoul National University
1985	B. S.	Chemical Education, Seoul National University

Professional Career

2014	Present Director of Brain Research & Advanced Medical Platform Technology, National Research Foundation of Korea (NRF)
2004	Present Principal Researcher, Center for Neuroscience, KIST
2003-2004	Visiting Research Professor, Northwestern University
1999-2004	Senior Researcher, Biomedical Research Center, KIST

범부처 특별 세션

국내 의료기기산업 육성을 위한 복지부·진흥원 지원방안

이름: 박순만
직위: 실장
소속: 한국보건산업진흥원

Abstract

국내외 의료기기 시장현황을 제시하고 유망한 한국 의료기기 품목 등 우리나라 의료기기 산업 경쟁력을 진단해본다. 국내 의료기기 산업육성을 위해 보건복지부와 한국보건산업진흥원의 지원사업을 R&D와 비R&D사업으로 구분하여 제시한다. 미래융합의료기기개발, 의료기기 임상시험 지원, 신의료기술 수반 의료기기 시장 진출 지원, 의료기기 중개임상시험 지원센터 등 올해 R&D사업을 설명하고, 국산의료기기 신제품 사용?자 테스트 지원, 의료기기산업 특성화 대학원 지원, 의료기기 국제규격 변화대응 지원, 의료기기 종합정보제공 등 비R&D 사업을 설명한다. 마지막으로 향후 우리나라의 의료기기산업이 2020년 세계 7대 강국으로 진입하기 위한 비전을 제시한다.

Brief Biosketch

2004.5~현재 한국보건산업진흥원 의료기기산업지원실 실장
식품의약품안전처 의료기기위원회 위원
식품의약품안전처 정책자문위원회 자문위원 등

식약처 특별 세션

좌장 : 김혁주 과장 (식품의약품안전평가원 의료기기연구과장)

의료기기 허가심사의 이해

박해대 연구관 (의료기기심사부 구강소화기기과)

첨단 의료기기 안전관리 연구개발(R&D) 추진 현황과 전략

이창형 연구관 (식품의약품 안전처 의료기기연구과)

금속 3D 프린팅 기술을 이용한 인공관절 생체코팅 기술 개발
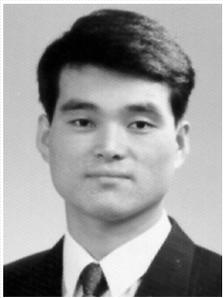
김정성 교수 (건양대학교 의료공과대학 의료신소재학과)

초음파를 이용한 영상 및 치료의 최신 기술동향

박주영 책임연구원 (대구경북첨단의료산업진흥재단 첨단의료기기개발지원센터)

식약처 특별 세션

의료기기 허가심사의 이해

이름: 박해대
직위: 연구관
소속: 의료기기심사부 구강소화기기과

Abstract

우리나라의 의료기기 관련 제도는 의료기기법을 근간으로 의료기기법 시행령, 의료기기법 시행규칙이 마련되어 있고 더 세부적으로 의료기기 허가·신고·심사 등에 관한 규정, 의료기기 품목 및 품목별 등급에 관한 규정 등에서 의료기기 허가 등에 대한 사항을 규정하고 있다. 현행 우리나라 의료기기 관련 정부 조직상의 담당부서, 허가심사와 관련한 사항을 요약·정리하였다.

Brief Biosketch

이력
1997~1998   식품의약품안전본부 의료기기안전평가부 의료기기규격과
1998~2013   식품의약품안전청 의료기기심사부 전자의료기기과, 의료기기허가심사팀, 치료기기과 등
2013~현재   식품의약품안전처 의료기기심사부 구강소화기기과

연구 등
의료기기 품목별 기준규격 마련
의료기기 품목별 안전성/성능 평가 연구사업
의료기기 허가심사 가이드라인 마련 등

첨단 의료기기 안전관리 연구개발(R&D) 추진 현황과 전략

이름: 이창형
직위: 연구관
소속: 식품의약품 안전처 의료기기연구과

Abstract

의료기기의 글로벌 메가트렌드는 신소재, 초정밀 가공, 메카트로닉스 등 IT·BT·NT 기술의 융합을 통합 고부가가치 첨단기술로 발전 중에 있다. 첨단기술이 접목된 고부가가치 의료기기 생산증가에 힘입어 '13년 우리나라 의료기기산업 시장규모는 4조 8,586억원으로 '08년 이후 연평균 11%라는 높은 성장세를 지속하고 있으며 '14년 시장규모는 5조원을 돌파하였다. 이와 같이 첨단 의료기기 산업이 발전하기 위해서는 신개발 첨단의료기기의 신속한 허가심사가 필수적이다. 아무리 신기술이 접목된 첨단 융복합 의료기기라 할지라도 허가심사라는 안전성 검증단계를 거치지 못하면 제품화 될 수 가 없다. 이를 위하여 의료기기 허가심사 부처인 식약처는 산업계, 학계, 연구소 등에서 개발된 신개발의료기기가 신속히 제품화 될 될 수 있도록 임상, 성능 등 안전성 평가기술 지표인 기준규격, 가이드라인 등을 개발하기 위한 연구사업을 수행하고 있다. 이들 연구사업 예산은 급증하는 첨단 융복합 의료기기에 부응하여 '13년 31.7억원에서 15년 79.4억원으로 대폭 증액되었다. 이들 연구사업을 통하여 개발된 가이드라인 등은 첨단 융복합 의료기기의 허가심사에 도움이 되어 의료기기산업 발전 뿐만 아니라 국민보건의료 향상에 크게 기여할 것으로 사료된다.

Brief Biosketch

85.2   한양대학교 섬유공학과 졸업(학사)
93.3   일본 동공대 유기재료공학과 졸업(석사)
96.3   일본 동공대 유기재료공학과 졸업(박사)
98.8   현재 식품의약품안전처

식약처 특별 세션

금속 3D 프린팅 기술을 이용한 인공관절 생체코팅 기술 개발

이름: 김정성
직위: 조교수
소속: 건양대학교 의료공과대학 의료신소재학과

Abstract

금속 3D 프린터를 이용하여 인공관절의 생체 코팅 기술을 적용한 사례를 소개한다. 특히 3D 프린팅 기술의 의료 분야 응용에서는 고분자 중심의 생체 소재를 적용한 사례가 대다수인데 비하여, 금속 중에서 생체친화성이 가장 우수하다는 티타늄을 이용하여 3D 프린팅 기술을 인공비구컵에 porous coating을 적용한 사례는 국내에서 많지 않다. 인공관절은 손상된 관절을 제거하고 그 부위를 대체하기 위한 인공 삽입물이며, 주요 인공관절로는 인체 내에서 가장 큰 하중을 지지하는 인공 엉덩이관절과 인공 무릎관절이 대표적이다. 인공관절은 10년 이상의 장기간 인체 내에 고정되어 안정성을 유지해야 하므로 기계적/생물학적 안정성을 보유해야 하는 고 난이도의 제품 군이며 특히 고령화에 따른 노인 인구의 골 관절염 발병률 증가와 비만율 증가로 향 후 가장 그 수요가 많을 것으로 기대되는 첨단의료기기 품목이다.

Brief Biosketch

인제대학교 의용공학과 공학석사
연세대학교 의과학과 이학박사
유앤아이㈜ 연구실장
메딕스얼라인㈜ 기술이사
㈜코렌텍 연구소장/이사

초음파를 이용한 영상 및 치료의 최신 기술동향

이름: 박주영
직위: 책임연구원
소속: 대구경북첨단의료산업진흥재단 첨단의료기기개발지원센터 의료영상팀

Abstract

초음파를 이용한 영상기법 및 치료법에 대해 적용 분야는 다양하다. 본 발표에는 두 가지 큰 화두에 대해 논의하고자 한다. 첫째는 초음파 영상기법의 최신기술동향이다. 초음파를 이용한 영상은 아주 오랫동안 연구 개발되어 왔다. 특히, 최근에 각광을 받고 있는Elastography와 Photoacoustics를 활용한 초음파 분자영상기술 및 응용사례에 대해 발표할 예정이다. 둘째는 초음파를 활용한 치료법에 대한 최신 기술동향이다. 비침습적으로 원하는 병변에서만 열 및 기계적 에너지를 전달할 수 있는 특징 때문에 새로운 치료법으로 주목을 받고 있다. 특히, MR-guided 혹은 US-guided 기반으로 뇌질환치료, 암치료, sonoporation을 활용한 약물전달 등의 치료초음파 기술 소개 및 응용사례에 대해 발표할 예정이다.

Brief Biosketch

▌경력

2010.5-2013.1   하버드대학교 의과대학 영상의학과 (Research Fellow)
2008.1-2010.4   미시간대학교 공과대학 의공학과(Postdoctoral Research Associate)

▌학력

2007.8   박사 신시내티대학교 공과대학 기계공학과 졸업
2005.3   석사 신시내티대학교 공과대학 기계공학과 졸업
2000.2   학사 건국대학교 공과대학 기계공학과 졸업

▌수상경력 및 대외활동

2012-2017   대통령 지정 포스닥 펠로우쉽 수여 (한국연구재단 선정)
2014-현재   대한치료초음파 학회 학술이사
2015-현재   프랑스 LE STUDIUM 기관 국제 과제 심사위원

의료기기 개발에서 꼭 필요한 측정 불확도와 소급성

좌장 : 안원식 (경희대학교 한의학과)

의료측정 신뢰성 평가 기술

안봉영 센터장 (한국표준과학연구원 의료융합측정표준센터)

측정의 시작과 끝: 소급성과 불확도

최종오 책임연구원 (한국표준과학연구원, 삶의질 측정표준본부)

의료기기 개발에서 참조표준 활용

김창근 책임연구원 (한국표준과학연구원 국가참조표준센터)

의료기기 개발에서 꼭 필요한 측정 불확도와 소급성

의료측정 신뢰성 평가 기술

이름: 안봉영
직위: 센터장
소속: 한국표준과학연구원 의료융합측정표준센터

Abstract

혈압, 맥박, 청진, 혈액, 영상 등 대부분의 의료진단은 과학적 관점의 측정 행위이다. 측정의 신뢰성은 국가측정표준 (National Measurement Standard)에 소급성을 유지할 경우에만 그 신뢰성이 확보되고 정밀 정확도의 유지가 가능하다. 다만 '의료측정 (Medical Metrology)'에서는 국가측정표준에 소급하지는 않지만 오랜 시간 동안 의료 사회에서 표준으로 인정받고 있는 'Gold Standard'를 기준으로 진단 및 치료가 수행되기도 하며, 이 경우 측정의 신뢰성은 의료기기의 성능 평가 (Performance Verification)를 통하여 검증된다. 본 연구에서는 의료측정표준 및 신뢰성 향상을 위하여 한국표준과학연구원 의료융합측정표준센터에서 수행중인 혈압계 성능평가, 의료초음파 출력 표준유지, 의료레이저 특성평가, MRI 안전성 기술, 의료영상정량화를 위한 인체 구조 및 조직 팬텀 개발 현황을 소개하고자 한다.

Brief Biosketch

연세대학교 학사 (물리학)/한국과학기술원 박사 (재료공학)
한국비파괴검사학회 편집이사, 편집위원, 전 초음파분과위원장
한국물리학회 정회원
물리음향연구교류회 회원
의료용 전기기기 신뢰성 표준기술 위원회 위원

측정의 시작과 끝: 소급성과 불확도

이름: 최종오
직위: 책임연구원
소속: 한국표준과학연구원, 삶의 질 측정표준본부

Abstract

과학 및 기술 관련 모든 연구·개발은 측정을 통해서 이루어집니다. 많은 분들이 측정은 기기가 하는 것으로 생각하고, 이야기를 하고, 연구결과를 발표합니다.

'측정은 사람이 합니다.'

'측정은 소급성으로 시작되어 불확도로 마무리됩니다.'

소급성과 불확도를 알아야 제대로 된 측정결과를 낼 수 있습니다. 이제 소급성과 불확도는 연구·개발을 하는 분들의 필수 지식입니다. 측정의 본질, 소급성 및 불확도의 개념과 그 필요성 및 중요성에 대하여 이야기합니다.

Brief Biosketch

▌이력

1981   한양대 공업화학과 공학사

1983   한양대 공업화학과(유기공업화학) 공학석사

1989   미 플로리다 주립대 물리유기화학 (광화학) 이학석사

1992   미 플로리다 주립대 분석화학 (chemometrics) 이학박사

▌연구 및 대외 활동

1994-현재   (화학) 측정학, 불확(실)도, 표준물질, 숙련도 평가 연구

국가지정 '화학분석 신뢰성' 연구실 운영

품질경영시스템 (ISO17025, 34, 43, 9001) 운영

측정능력평가, 측정품질, 측정표준종합관리 및 관련 교육 및 세미나

측정 및 표준 교육 (개념, 용어, 국제단위, 불확도, 소급성, 신뢰성 등) 및 가이드 7권

불확도 교육 및 자문 (교육/세미나 350회 이상)

  - 측정신뢰성 및 품질경영 (ISO 9001, 17025): 터키, 우즈베키스탄 등 중앙아시아 10국 순회

  - 해외 초청 세미나 및 자문 27회 : IAEA, APMP, APLMF, IMEKO, 필리핀, 인도네시아, 영국, 프랑스 등

의료기기 개발에서 꼭 필요한 측정 불확도와 소급성

의료기기 개발에서 참조표준 활용

이름: 김창근
직위: 책임연구원
소속: 한국표준과학연구원 국가참조표준센터

Abstract

의료정보시대를 맞아 수 많은 의료데이터들이 생산되고 활용되고 있다. 특히, 의료데이터에 대한 수요자인 의사, 연구자, 의료산업 등 에서 신뢰성 있는 의료데이터에 대한 수요는 증가하고 있으나 의료데이터의 신뢰성에 대한 평가 및 이들 데이터의 공급이 미비한 실정이다. 이런 어려움을 국가적으로 해결하기 위하여 보건의료분야 참조표준이 엄밀한 평가 과정을 거쳐 개발되고 있다. 데이터의 신뢰성을 보장하기 위해서는 데이터의 평가기준 수립, 평가기준에 의거한 데이터 평가 과정을 거쳐야 한다. 또한 이렇게 개발된 의료분야 데이터의 의료기기 개발에 활용하기 위한 방향에 대해 알아보고자 한다.

Brief Biosketch

▌학력
90. 3~95. 2   한양대학교 물리학 학사
96. 8~98. 8   한양대학교 플라즈마 물리학 석사
00. 3~03. 2   한양대학교 플라즈마 물리학 박사

▌이력
02. 11~04. 3   캐나다 INRS-EMT 연구소 박사후연수원(핵융합장치의 divertor simulation)
04. 8~05. 10   한국 기초과학지원연구원 박사후 연수원(KSTAR Divertor simulation)
5. 11. ~ 현재   한국표준과학연구원 국가참조표준센터 책임연구원

신진연구자 세션

좌장 : **장동표** (한양대학교 의생명공학전문대학원)
박중열 (중앙대학교 기계공학부)

Advanced MRI: Imaging Myelin in the Brain
이종호 조교수 (서울대학교 전기, 정보공학부)

양전자방출단층촬영기 연구 동향(Research Trends in
Positron Emission Tomography Instrumentation)
염정열 조교수 (고려대학교 보건과학대학 바이오의공학부)

High-frequency Ultrasound Microbeams toward Cancer Research
황재윤 조교수 (대구경북과학기술원[디지스트])

Obstacles Facing Biomedical Engineering;
Dealing Medical Problems with Engineering Solutions
김성훈 조교수 (울산대학교 의과대학 서울아산병원 마취통증의학교실)

신진연구자 세션

Advanced MRI: Imaging Myelin in the Brain

이름: 이종호
직위: 조교수
소속: 서울대학교 전기, 정보공학부

Abstract

Myelin is a dielectric material that forms layers around a nerve fiber (i.e. axon). It provides electrical insulation and induces salutatory conduction in the nerve system. Hence, it has an essential role in normal brain function. It has been observed that major fiber bundles or cortical areas in the brain have large variation in myelin density. This suggests a potential relationship between myelin content and brain function or metabolism. Recently, several technical developments in MRI have enabled us to measure brain myelin content both in gray matter and white matter. In this talk, I will present new progresses in white matter myelin imaging.

Brief Biosketch

Jongho Lee received B.S. degree in Electrical Engineering at Seoul National University (1998) and completed M.S. (2004) and Ph.D. (2007) degrees in Electrical Engineering at Stanford University with a Ph.D minor in Psychology. From 2007 to 2010, he worked at the National Institute of Neurological Disorders and Stroke, National Institutes of Health, USA as a research fellow. From 2010 to 2014, he continued his academic career as an Assistant Professor at the Department of Radiology, University of Pennsylvania. In 2014, he moved back to Korea to join a faculty position at the Department of Electrical and Computer Engineering, Seoul National University.

Dr. Lee is a recipient of International Rotary Foundation Ambassadorial scholarship for his M.S. and Samsung Scholarship Foundation scholarship for his Ph.D. He awarded Young Investigator Grant Award from Korean-American Scientists and Engineers Association (2012) and Young Investigator Award at White Matter Study Group workshop, International Society for Magnetic Resonance in Medicine (2013).

양전자방출단층촬영기 연구 동향
(Research Trends in Positron Emission Tomography Instrumentation)

이름: 염정열
직위: 조교수
소속: 고려대학교 보건과학대학 바이오의공학부

Abstract

Positron emission tomography (PET) is a nuclear medicine imaging technique that uses radioactive tracers attached to biologically active molecules to produce three-dimensional images of functional processes in the body. In this presentation, recent research trends in PET instrumentation, including but not limited to, techniques such as ultrahigh resolution scanners, Time-of-Flight PET, depth-of-interaction (DOI), multi-modality imaging and image reconstruction/processing are covered.

Brief Biosketch

Prof. Yeom acquired his B.Sc. from Department of Nuclear Engineering, Seoul National University and his M.Eng./Ph.D. from the Department of Quantum Engineering and Systems Science, University of Tokyo. He has had prior work/training experiences at Seoul National University Hospital, LG Electronics, Stanford University and Kumoh National Institute of Technology before joining Korea University.

신진연구자 세션

High-frequency Ultrasound Microbeams toward Cancer Research

이름: 황재윤
직위: 조교수
소속: 대구경북과학기술원(디지스트)

Abstract

For a few years, many high-frequency ultrasound microbeam technologies including acoustic tweezers and acoustic beam stimulators have been developed for various biomedical applications. In this talk, our recent research on the high-frequency ultrasound microbeam technologies toward cancer research is mainly demonstrated. The typical width of the high frequency ultrasound beam at focus is only a few microns, comparable to the sizes of many cells, thus called "ultrasound microbeam". For generation of the ultrasound microbeam, lithium niobate (LiNbO3) single element transducers at 30-200 MHz (f-number: $<$ 1.3) are successfully fabricated and acoustic tweezers, acoustic beam stimulators, and a PA-ARFI microscope, devised with the transducers, are then employed to manipulate single breast cancer cells, quantify their mechanics, and characterize their phenotypes. The experimental results are here shown, thus demonstrating that the high frequency ultrasound microbeam techniques may potentially become a novel non-contact tool in various cancer research in vitro and in vivo.

Brief Biosketch

Dr. Hwang received his Ph. D. degree from the BME department at USC. His dissertation focused on the development of a multimode optical imaging system for preclinical applications in vivo and ex vivo. He then worked as a postdoctoral fellow in Cedars-Sinai Medical Center, exploring biomedical applications of the multimodal imaging system. After his postdoctoral training, he moved to the NIH Resource Center for Medical Ultrasonic Transducer Technology to develop novel multimodal imaging technologies by combining high-frequency ultrasound and optical imaging technologies. He is currently an Assistant Professor in the ICE Department at DGIST. His research interest includes the development of novel multimodal imaging systems, mobile imaging and healthcare devices, and high-frequency ultrasound microbeam techniques.

Obstacles Facing Biomedical Engineering; Dealing Medical Problems with Engineering Solutions

이름: 김성훈
직위: 조교수
소속: 울산대학교 의과대학 서울아산병원 마취통증의학교실

Abstract

To achieve greater synergies in research and development, all disciplines should be systemically organized. In particular, biomedical engineering requires interactive collaboration between the medical engineering specialists and the medical researchers in clinics. However, many researchers feel that there are quite a lot of barriers in reaching the engineering department for sharing medical ideas to ultimately develop new kits or instruments. In this session, I'd like to talk about such barriers from a clinician's perspective. In fact, many clinical researchers think their ideas are not only clinically significant, but also can readily be incorporated into technology. However, clinical significance per se is not always necessarily transferred to the engineering significance. In my master thesis, I found out that beat-to-beat pulse transit time was closely correlated with systolic blood pressure during anesthesia induction period in hypertensive patients undergoing kidney transplantation. The paper received favorable reviews and was published in a good journal with an impact factor of 3.4. With a flighty mind, I tried to apply for a patent and searched for an interested manufacturer. Unfortunately, I was disappointed to hear a very cynical answer from the attorney and developer. They considered that my finding was nothing new in the mechanical viewpoint. Clinical significance and engineering development possibilities do not always match, but I was not aware of that. In my personal opinion, not a small portion of clinicians are still not aware the basic concept. It is important that clinical researchers and scientists should sit at a table and talk about their research open-mindedly. In order to make this more feasible, research ecosystem, such as bio-complex, should be set up and maintained in a closed relationship. We, clinical researchers and engineers should work together to overcome practical barriers in order to firmly develop biomedical engineering industry for the future of mutual benefit.

Brief Biosketch

- 한양의대 졸업 (2005), 의학박사 (2014)
- 대한마취과학회 (2006~), 대한의용생체공학회 (2011~)
- 젊은 연구자상 (2012, 대한통증학회), 우영 학술상 (2013, 대한마취과학회)
- 서울아산병원 마취통증의학과 CPI 담당 교수
- Research Interest: Bio-signal analysis, Biomedical Statistics

의사, 의공학자를 위한
의료기기 ISO 규격

좌장 : 안원식 (경희대학교 한의학과)

수술실에서 사용되는 의료기기 국제규격

박재홍 교수 (인제대학교 의과대학 마취통증의학교실)

검사실에서 사용되는 의료기기 국제규격

박애자 교수 (중앙대학교병원 진단 검사의학과)

전자의료기기 국제 규격(IEC-TC62중심) 동향

허 영 의료기기 PD (한국산업기술평가관리원)

의사, 의공학자를 위한 의료기기 ISO 규격

수술실에서 사용되는 의료기기 국제규격

이름: 박재홍
직위: 조교수
소속: 인제대학교 의과대학 마취통증의학교실

Abstract

의료진이 의도한 일이든 혹은 의도하지 않은 일이든 간에 수술 중 환자의 몸에는 많은 변화가 발생하게 되는데, 이러한 변화를 조기에 감지하고 적절하게 대처하기 위해 많은 의료장비들이 사용되게 된다. 이번에 소개할 내용은 그 중에서도 가장 중요한 장비들인 혈압계와 맥박 산소계측기에 관한 국제규격으로, 혈압계에 관한 국제규격인 ISO 80601-2-30 (Medical electrical equipment – Part 2-30: Particu lar requirements for the basic safety and essential performance of automated non-invasive sphygmomanometers)과 맥박산소 계측기에 관한 국제규격인 ISO 80601-2-61 (Medical electrical equipment – Part 2-61: Particular requirements for basic safety and essential performance of pulse oximeter equipment)를 다루도록 하겠다.

Brief Biosketch

계명대학교 의과대학 졸업
계명대학교 동산의료원 마취통증의학과 전공의 과정 수료
인제대학교 해운대백병원 조교수
식품의약품안전평가원 의료기기 외부전문가
2014년도 한국표준과학연구원 참조표준 및 불확도 연구용역 진행
대한마취과학회 표준개발소위원회 위원 및 간사
대한마취약리학회 정회원 및 기획위원

검사실에서 사용되는 의료기기 국제규격

이름: 박애자
직위: 교수
소속: 중앙대학교병원 진단 검사의학과

Abstract

하나의 나라안에서도 산업분야에 국가 표준이 필요하듯 국제간의 제품이나 서비스를 주고받는 무역의 관점에서도 국가간 서로의 소통을 위해 같은 표준을 사용해야 하는 시대이다. 오래 전부터 선진국들은 수많은 산업분야에서 대량 생산을 위한 분업화 과정 안에서 만들어지는 제품들의 품질문제도 해결해야 만 하는 당면문제가 발생하게 되었다. 이렇게 수많은 기술 중 의료분야, 특히 병원을 찾는 환자들에게 검사실에서는 보다 정확하고 정밀도가 높은 체외진단용 의료기기의 선택이 필요하기 때문에 국제적 표준화 기구에서 제정된 많은 품질문서들이 절실했다. 최근 급속도로 발전하고 있는 바이오분야 기술로 인해 제정된 국제규격- 표준문서들, 특히 검사실용 의료기기에 국제규격을 모른다면 검사실을 운영할 수 없는 게 현실이다. 1994년에 설립된 국제표준화기구 내 검사실 검사 및 체외진단용 의료기기체제의 이름을 가진 TC212는25종의 중요 문서를 개발제정 개정하고 있는데, 이 표준문서들에는 검사실의 품질 경영 및 기술 경영을 위한 문서 뿐만 아니라 하나의 검사종목이 환자나 임상의에게 서비스로 제공되기 위하여 검사실에서 어떻게 측정해야 하고 정확도와 정밀도는 물론, 의료장비 및 사용시약의 소급성과 해당 검사종목의 측정치가 가지는 불확도 관련 표준문서, 그리고 검사실 인정이나, 표준 실험실이 갖추어야 할 기준 등을 제정하였다. 최근 검사실에서도 바이오기술의 발전으로 이를 활용하여 질환의 진단과 치료, 그리고 추후관찰에 활용하는 각종 병원체의 정량측정을 위한 품질문서, 그리고 환자 곁에서 쉽게 사용 가능한 현장검사기기들의 제조자들의 요구조건 등을 제정하는 문서들을 소개하고자 한다.

의사, 의공학자를 위한 의료기기 ISO 규격

전자의료기기 국제 규격(IEC-TC62중심) 동향

이름: 허 영
직위: 의료기기 PD
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Abstract

의료기기산업은 경제성장과 더불어 고령화 사회의 도래로 그 수요가 크게 증가하고 있는 신성장동력 산업으로서, 관련 기술표준은 연구개발단계에서 가장 우선시 고려되어야 한다. 의료기기분야의 국내표준으로는 국가기술표준원에서 운영하는 KS와 식약처의 의료기기법에 의한 기준규격이 있다. 전자의료기기 표준인 IEC TC 62 (Electrical equipment in medical practice)는 4개의 분야별 SC (Sub Committee)를 구성되어 운영하고 있으며, 최근에는 3판이 전 세계적으로 적용되고 있는데, 이는 필수성능, 위험관리, 사용적합성 등 제품설계에 대한 요구사항이 크게 증가하여 개발자나 제조기업등 에게는 매우 큰 부담으로 작용 하고 있다. 본고에서는 간략히 IEC 의료기기 국제 표준동향과 최근 이슈에 대해 소개 하고자 한다.

Brief Biosketch

▌학력
1995년	미국 텍사스주립대학교 졸업 (공학박사)
2005년	미국 University of Washington (Seattle) Medical Center 방사선과 연수

▌경력
2011년	IEC-TC 62 전문위원회 위원장(국가기술표준원)
2013년	미래부 국가 30대 중점기술 전략로드맵 의료기기팀장
2013년	의료기기 위원 / 심의위원(식약처)

2015년도 제50회 대한의용생체공학회 춘계학술대회

일반연제 1, 2

일반연제 1 좌장 : 유홍기 교수 (한양대학교 공과대학 생체공학과)
유형석 교수 (울산대학교 의공학전공)

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일반연제 1 (Biomedical Optics, Medical Imaging, Nano/Microtechnology, u-health, e-Health, m-Health)

Biomedical Optics
Medical Imaging
Medical Nano and Microtechnology
U-Health, e-Health.m-Health Technology

일반연제 2 (Neural Engineering, Respiratory Engineering, Tissue Engineering and Biomaterials)

Biomedical Engineering Education and Career
Neural Engineering
Respiratory Engineering
Tissue Engineering and Biomaterials
Neural Engineering

일반연제 1, 2

일반연제 1

Biomedical Optics

다기능 광간섭단층영상 기반 화상진단 연구

김범주, 레허안, 윤여름, 김기현
포항공대 기계공학과 및 융합생명공학부

Burn is the tissue damage induced by heat, electricity etc., and its precise diagnosis of burn depth is important for treatment decision. The current diagnosis method relies on surgeon's expertise and various measurement methods have been developed as objective aids for diagnosis. In this study, multi-functional optical coherence tomography providing structural, birefringent, and vascular information was applied to a rat burn model in vivo. Changes in all these parameters were observed in the burn induced skin. Changes of the burn wound in the first 3 days after damage induction will be observed in order to extract useful parameters for helping objective diagnosis of burn damage.

Medical Imaging

정량적 피부 진단/관리를 위한 모바일 다중 분광 이미징 시스템

김세웅[1], 조동래[2], 박진만[2], 이보름[2], 황재윤[1]
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A multispectral imaging system has shown its great potential as a quantitative imaging tool in biomedical research. We here demonstrate a mobile multispectral imaging system attached to a smartphone for quantitative detection and monitoring of skin lesions. This system consists of ten bandpass optical filters, polarizers, and etc. For system control and spectral imaging analysis, an Android application was developed and connected to a server including spectral classification program based on spectral angle measure. To evaluate the performance of our developed system, acne regions of interest have been quantitatively monitored while benzoyl peroxide treatment for 7 days using the system.

자기공명영상 도전율 측정 기법 및 직류 저항 측정을 통한 세포내 도전율 추정법

김준형, 김민오, 신재욱, 김동현
연세대학교 전기 전자 공학과

Several researches about measuring electrical property using magnetic resonance imaging (MRI) are reported, such as MR current density imaging (MRCDI), MR electrical impedance tomography (MREIT) and MR electrical property tomography (MREPT). In addition, diagnostic applications of electrical conductivity maps are reported also. These methods measure electrical properties at different frequencies and thus the measured values depend on their own frequency. Due to the dependency on frequency, the measured conductivity values at different frequency reveal physiological properties of tissue such as ion concentration, cell structure and water content. Therefore, in this study, we measure electrical conductivity values of Flying-fish roe at low and high frequency to observe intracellular and extracellular conductivity. Direct current ohmmeter and MREPT technique were used.

Medical Nano and Microtechnology

광유전학적으로 설계된, 단백질 수송 엑소솜 생산기술

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Optogenetically-engineered protein-carrying exosomes Nanoparticle-mediated protein delivery is a promising method to treat various human diseases in clinical use. Among nanoparticles, cell-derived exosomes have been highlighted recently in new therapeutic strategies for the in vivo delivery of siRNA and miRNA. Here we describe a new optogenetic tool for direct delivery of target proteins to other cells. By integrating a blue light-mediated protein-protein interaction module, based on cryptochrome 2 (CRY2) and CIBN, fused with CD9, a representative marker protein of exosome biogenesis, we successfully docked cargo proteins into newly generated exosomes under blue light illumination. Administration of these protein-encapsulated exosomes enables intracellular transfer of functional cargo proteins into target cells.

U-Health, e-Health. m-Health Technology

Mental Task 수행에 의한 전전두엽 활성 부위의 fNIRS 기반 추정

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[2]삼성전자 DMC 연구소
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The fact that some mental tasks like mental arithmetic induce the activation of prefrontal cortex of brain has been studied using hemodynamic imaging modalities. In this study, we focused on the different activated area of local prefrontal brain because of the different mental activities not only focusing on the classification accuracy of in-house fNIRS system. The study required the preliminary validation about the conditions of enough signal quality including the contacts between all detectors and prefrontal area. Then, the result of mental tasks showed the different tendencies of highly correlated prefrontal area.

일반연제 2

Biomedical Engineering Education and Career

완전 이식형 보청기용 마이크로폰의 성능 개선을 위한 그래핀 진동막 제작

안형준[1], 우승탁[1], 한재형[1], 조유진[2], 김종훈[2]
임형규[1], 성기웅[3], 이정현[3], 최무한[1], 조진호[1]
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[3]경북대학교병원 의공학과

The microphone for fully implantable hearing aid was placed below the skin. A performance of implanted microphone is decreased because the collected sound via the microphone is absorbed or scattered by the skin. Therefore, we suggested a graphene diaphragm to improve the performance of the microphone. For experiment, monolayer graphene laminated films were produced using a chemical vapor deposition (CVD). To confirm availability of the microphone diaphragm, the vibration of diaphragm was measured according to the thickness using a laser Doppler vibrometer. In this study, the diaphragm exhibited larger and thinner than ones of conventional diaphragm in displacement and thickness, respectively.

Neural Engineering

단기연관 및 장기연관기억 기능 평가를 위한 실험 패러다임 개발 및 평가

신가인, 김태경, 박진식, 김인영, 김선일, 장동표
한양대학교 생체공학과

While hippocampus is well-known to play an important role in long-term memory, Husain et. al.

reported that it also has a relationship with binding memory of object's shape and its spatial location. In this study, we adapted Husain's protocol and conducted experiment for evaluation the effect of workload on binding memory. Considering two known facts about hippocampus, experiments on both long-term memory and short-term binding memory were hold. Each of the participants (fourteen male and thirteen female) took two tests with exactly the same paradigm, but with the different workload. The results showed increase in workload affected binding memory ability of male's. However, long-term memory task had no significant effects due to workload increment.

Respiratory Engineering

복합진단기기 개발: 진단알고리즘 개발을 위한 폐음 분석

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Intellectual technologies are rapidly spreading into many medical fields including diagnostics. Digital stethoscope has been developed and used to obtain biological sound. However, the development of diagnostic algorithm is necessary to facilitate clinical applications. In order to develop the diagnostic algorithm of lung sound, we investigated the method to acquire patients' lung sound by using MP150 data acquisition system (BIOPAC). Six subjects were included and lung sounds were acquired. High frequency bands were successfully recorded in patients with bronchial stenosis and wheezing sound. Further accumulation of data will follow for the development of diagnostic algorithm.

Tissue Engineering and Biomaterials

Biodegradable Suture Enabled with Sustained, Local Delivery of Pain-relief Drug

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Oral administration of non-steroidal anti-inflammatory drug (NSAID) has been widely used to treat the pain after the surgery. However, this therapy may cause gastrointestinal (GI) complications. In this aspect, local delivery of NSAID can be a promising way of therapy. In this work, therefore, we fabricated a drug delivery film, composed of a biodegradable polymer (poly (lactic-co-glycolic acid (PLGA)) and a pain relief drug (diclofenac, DF). The original biodegradable suture was physically winded with the drug delivery film. After that, in vitro drug release study and in vivo animal experiments were performed, respectively.

Neural Engineering

기능적자기공명영상 기법을 사용한 Stereoscopic 3D 영상과 Shaded 3D 영상의 작용 기억 처리 과정에서 신경학적 신호의 차이 분석

최혜정
경북대학교 의용생체공학과

Working memory is a cognitive system for tempo-

rary storage and manipulation of information, which plays a crucial role in complex cognitive skills. A few studies evaluated visuospatial working memory in relation to information about 3D scene or object, but there are no studies that have directly investigated neural processing of N-back task using stimuli as 3D object. The aim of current study was to compare the differences of neural activity during performing N-back task using stimuli as between stereoscopic 3D object and shaded 3D object.

POSTER I

Biomedical Engineering Education and Career

Cardiovascular Engineering

Orthopedic and Rehabilitation Engineering

Respiratory Engineering

U-Health, e-Health.m-Health Technology

POSTER I

Biomedical Engineering Education and Career

P1-01 좌심실보조장치를 이식한 실험동물의 관리를 위한 원격 모니터링 시스템

오성근, 김영일, 강성민, 최성욱
강원대학교 기계의용학과

Managing the animals implanted ventricular assist device (VAD) in a stable condition is very important. For the stable management of laboratory animals should be observed in real time the status of all of the animals and the VAD, VAD after transplantation should be able to quickly respond in case of animals and more than a VAD signs and emergency situations. Depending on the condition of the experimental animal it is necessary to control the VAD, and also to be observed the state of the control animals according to the VAD. In this study, we developed a real-time program the VAD to check and control the status of the VAD and status of animals in the external (remote) from the outside to control and experimental animals transplanted VAD using the remote control system should be managed as a long-term stable state.

P1-02 Feasibility study of low level light therapy on human annulus fibrosus in the intervertebral disc degeneration

M.H. Hwang, J.H. Shin, G. E. Jo, K. S. Kim
H.G. Nam, S.M. Baek, C.M. Yoo, H. Choi
Department of Medical Sciences
Graduate School of Medicine, Korea University

Intervertebral disc degeneration is an important cause of chronic intractable low back pain (LBP) and is associated with inflammation induced by cytokines released from macrophage in the annulus fibrosus (AF). The purpose of this study is to investigate the effects of low level light therapy (LLLT) on the AF in disc degeneration. We showed that the macrophage conditioned medium (MCM) modulated the production of extracellular matrix (ECM)-modifying enzymes. LLLT modulated MCM-induced ECM-mediated disc degenerative enzymes expression at a specific dose. These data provide for the potential LLLT application of chronic disc degenerative low back pain.

P1-03 심전도와 호흡 신호의 동시 측정을 위한 웨어러블 계측기

박영빈[1], 웨이췬[2], 이상준[3], 임형규[1,3], 신동호[1]
박효순[1], 이장우[1], 강신원[1], 조진호[1,3]
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[3]경북대학교 의공학연구소

In modern society, many people have an interest in U-health, which can offer health service without limitation of time and location. So, instrument which measures bio-signals is more important. For U-health, it is suitable that the measuring instrument has flexible and wearable. Generally, Ag-AgCl electrode has been used for collecting the bio-signals. However, it is not suitable for U-health instrument which has flexible and wearable, because this electrode may cause irritation or cannot use in the long-term. In the study, convenient electrodes for wearable instrument were fabricated using a conductive fabric. And ECG and respiratory signal were acquired and processed. To verify feasibility of the fabric electrode, the measured bio-signals were compared with measurements by Ag-AgCl electrodes.

P1-04 Effect of frequency dependent micro-biphasic electrical current on annulus fibrosus (AF) cells during the intervertebral disc degeneration

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H.G. Nam, S.M. Baek, C.M. Yoo1, H. Choi
Department of Medical Sciences
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Symptomatic disc degeneration is mainly caused by repetitive mechanical stress on outer annulus fibrosus (AF). The stress causes tear in AF and this leads to chronic intractable lumbar pain and symptomatic disc degeneration. Our research group have investigated the effect of micro-biphasic electrical current (BEC) stimulation on inflammation induced nemotic hAF cells, which mimicked hAF tissue disruption, and stimulation was applied in an acceptable range for human being using microcurrent stimulation chip (MSChip). In order to mimic the inflammatory reaction of macrophage we exposed naïve hAF cells to macrophage conditioned media (MCM) and induced inflammation in vitro. Also, by applying MSChip, we analyzed micro-biphasic electrical current (BEC) treated nemotic AF cells for investigating the effect of a micro-BEC. We suggested that micro-BEC stimulation on inflammation induced nemotic hAF cells inhibits inflammatory cytokines and expected it might be used as effective treatment tool.

P1-05 최소 침습적 수술(Minimally Invasive Surgery)을 위한 새로운 리트랙터(Retractor)의 안전성 평가

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[2]오송첨단의료산업진흥재단 첨단의료기기지원센터

The purpose of this study is to biocompatibility and biomechanical evaluation of the retractor. Retractor is designed using a CAD program (PRO/E), which is manufactured by medical titanium alloy material. Results of the dynamic test of development products, fracture of 10,000cycle in the product did not occur. Average bending strength of Frame indicates 22.9kN, Blade cantilever test average maximum load showed 320.7N. According to testing results, a development product indicates the biocompatibility and biomechanical stability, it is considered to be suitable for clinical application. However, for additional verification, construction analysis and guidelines more systematic mechanical performance is required.

P1-06 싸이클형 하지 재활 시스템 개발

신선혜[1], 유창호[2], 홍철운[2], 홍정표[3]
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This research was to develop the cycling system of lower limbs for early rehabilitation during bed laying. 23 Healthcare Engineer participated. They assessed a cycling system about each indices of stability, comfort, usability, efficiency etc. Most of the subjects satisfied with comfort and stability but, they had lower satisfaction on weight and price. This study presented a usability evaluation results of the rehabilitation device and thus will be used as reference data in the later development device.

P1-07 안경형 비접촉 눈 깜박임 측정 디바이스와 깜박임 기반 실시간 스펠러

이정수[1], 이원규[1], 이홍지[1], 임용규[2], 박광석[1,3]
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[3]서울대학교 의과대학 의공학교실

In this study, we introduce non-contact blink detection glasses utilizing transparent conductive film for ALS patients who can only move their eye. The glasses overcomes the shortcomings of conventional

blink detection system and detect blink without electrical contact. To validate the system, we developed online blink based speller. The result shows that ITR is 10.60 letter/min with 100% accuracy.

P1-08 3차원 심장조직 모델과 체표면 전위맵을 이용한 부정맥 예측 시뮬레이션

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The Cardiac arrhythmia is expressed in re-entry waves in numerical 3 dimensional cardiac electrophysiology model. The wave length of ventricle and atrium electrophysiology model calculated APD(action potential duration) multiply CV(conduction velocity) that is an important factor for re-entry wave generation and wave breakup. FibN(fibrillation number) and e-Re(e-Reynolds number) are the index of predicting cardiac arrhythmia. The ratio of heart size and wave length those are determining the arrhythmia as Reynolds number. A BSPM (Body Surface Potential Mapping) can visualize the electrophysiology of native heart directly. It is attached to thoracic case surface through multi-channel electrode. In this study, we analyzed wave length of normal case and arrhythmia case using visualization method in order to analyze the simulation results of 3D heart model and body surface potential map. These results provides an index of cardiac arrhythmia vulnerability and potential gradient of BSPM.

P1-09 나노여과 비압력구동 엑소좀 분리의 전기장 효과

Ali Karimi, 천홍구
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We present a theoretical model of an electrically

enhanced non-pressure-driven filtration process for separation of small sized particles bellow extracellular vesicles size by numerical integration of Stokes-Einstein relation equation accounting for the electric field, hydrodynamic, and Brownian forces. In this work the parameters that affect performance of the method are numerically investigated, that enables us highly efficient isolation, size separation using serial different nano-membranes, fast and simple system without using special equipment that provides important insights in NF systems.

P1-10 켈빈 프루브 현미경을 이용한 DNA/나노 입자 복합체 기반의 유전자 단일 돌연변이 검지 및 농도 동시측정 연구

이형빈[1], 이원석[1], 최승엽[1], 이상원[2]
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Detection of gene mutation that is closely associated to many kinds of disorders and carcinoma is of greatly important for molecular diagnosis. Here we report a highly efficient and sensitive detection of BRCA1 point mutation by probing individual surface potential of DNA/gold nanosphere (GNS) using Kelvin probe force microscopy (KPFM). In a one-step KPFM imaging assay, dozens of DNA/GNS complexes provide a robust, reliable statistical analysis of very small amounts of target DNA sample (~0.8 femtomole μl-1).

P1-11 마이크로 입자 분석 및 정량화를 위한 전위차 미세세포계수칩

Wenliang Yao[1], 천홍구[2]
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[2]고려대학교 바이오융합공학과

Lab-on-chip technologies are being developed widely by many researches for various applications such as cell analysis in terms of point of care diagnosis and global health. Impedance measurement offers a non-invasive method for cell counting, identifying and monitoring cell function [1]. Maxwell's mixture theory well describe and model the dielectric properties of particles in suspension which widely used in medical instruments such as Coulter Counter [2,3]. Here we develop a novel potentiometric cytometer microchip which is able to analysis and quantify micro particles that size close to cells dispersed in liquid with different concentrations. The experiment result corresponds well with the prepared sample of micro particle dispersions. The result of this research will be useful to design the prototype of commercial microfluidic cytometer.

P1-12 콘택트렌즈의 성능평가 표준시험법 개발을 위한 시험규격 분석

허지연[1], 이희성[1], 조은정[1], 김미혜[1], 김형식[1]
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The final purpose of this study is to develop for standard operating procedures of contact lens. This study is a basic research for the development of a standardized test method of the contact lens, we compared and analyzed domestic and foreign standards. Especially, standards of the FDA, the Japanese Ministry of Health, Labour and Welfare(MHLW) and ISO were used in this study and compared the medical device standards of MFDS; test items, test methods, equipments etc.

P1-13 시공간 분석에 기반한 기능적 근적외선 영상 재구성

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Non-contact based near-infrared (NIR) optical imaging devices are developed for non-invasive tissues imaging in various clinical applications. In the current study, the spatio-temporal mapping of blood vessels based on functional information was performed using NIR optical imaging without the use of external contrast agents.?The spatio-temporal features of dynamic NIR data were extracted from the cuff experimental data to localize vessel according to blood dynamics. Demonstrating the spatio-temporal feature of blood dynamic imaging using a portable non-contact NIR imaging device without external contrast agents is significant for applications such as peripheral vascular diseases and wound screening

P1-14 저강도 집속 초음파를 이용한 뇌혈관장벽 개방에 따른 예비결과 및 트러블슈팅

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We studied the effect of focused ultrasound on blood-brain barrier opening and the sonication parameters for targeted drug delivery. To find the optimal sonication parameters for the BBB-disruption, we examined various sonication conditions. We showed some results with Evans blue (about 900Da) which show solutions of very large molecular weight could be diffused through the disrupted BBB. And we also demonstrate the optimal BBB-disruption condition of the ultra-sonication for drug delivery. It is expected that this technique can be applied for targeted drug delivery into the localized brain area.

P1-15 사고활동이 전두엽 활성화에 미치는 영향

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This study was to investigate the effects of brain activation in the game is a real person to promote thinking and concentration of cognitive function, the arithmetic problem targeting 25 six people were attending SoonChunHyang University for two minutes. Prefrontal cortex increased beta relative stability compared with the time when the state was given a computational problems selling this means that the neurons in the frontal lobe activation. Through changes in brain waves, thinking promote the game was confirmed that affects the brain activation.

P1-16 전도성 섬유 기반 보행패턴 알고리즘 개발의 기초연구

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순천향대학교 의료IT공학과

We have developed a conductive textile-based insole for gait analysis which has pattern recognition. The suggested insole size is 265 mm and was configured a pair of conductive textiles. In order to convert to digital signal, we were designed MCU which has ADC and UART function and it was transferred data to smartphone application. Data was stored in android inner database. Data analysis was executed in matlab. As a result, raw signal is filtered 2nd order low-pass filter. Through obtained results in this study, it will be helpful about gait analysis.

P1-17 보행 시작, 진행, 종료 시 분속수에 따른 COP, COM, XcoM 분석

박선우, 신이수, 최은경, 차백동, 김종만, 김영호
연세대학교 의공학과

Standing stability cannot be properly applied to walking, or even standing, as it does not take into account the horizontal velocity of the COM. In this study, we investigated the influence of cadence on COP, COM and XcoM in gait initiation, constant speed walking and gait termination. Twenty healthy subjects participated in the study and performed level walking under three different cadences. In the results, XcoM AP and ML displacement significantly increased as cadence increased in gait initiation and constant speed walking. XcoM-COMFoot and XcoM-COMStep increased to be constant in gait initiation and constant speed walking and decreased in gait termination along the direction of progression.

P1-18 전 도성 섬유 기반 압력센서 및 모니터링 시스템 개발

왕창원, 정화영, 나예지, 민세동
순천향대학교 의료IT공학과

In this paper, we designed a conductive textile-based pressure sensor and monitoring system for gait assessment. Pressure sensor size is 1x30cm2. And we measured capacitance change by weights which has 1 kg to 10kg, to see a difference of capacitance. As a result, capacitance value showed increase to linear characteristic. Also, in order to convert digital signal from analog capacitance signal, we were designed cap sensor and were used AD7747 CDC chip and were transferred data based on c#. Through obtained results in this study, would be helpful about various study related to conductive textile for gait analysis.

P1-19 단일 세포 단위의 시공간적 조절이 가능한 정량적 형질전환

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Transfection is widely used analytical tool allowing study of the function of genes and control gene expression. However, conventional transfection methods have difficulty controlling spatio-temporal differences in gene expression levels or the quantity of delivered materials. Here, we present a spatio- temporally controlled transfection strategy using quantitative injection into a single cell. We quantitatively delivered DNA into a single cell at desired location and time. Through this method, we obtained optimal gene delivery and expression conditions based on the amount of the delivered DNA and the transfection efficacy. Our study suggests that this technique may be used for cell biological researches.

P1-20 Enhanced thermal effect of high intensity focused ultrasound (HIFU) assisted with laser application

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Laser-enhanced thermal effects during high intensity focused ultrasound ablation was studied in vitro. During the study, a single element HIFU transducer with a central frequency of 2.0 MHz was used to induce tissue coagulation on bovine liver. Laser light was employed to illuminate the sample concurrently with HIFU exposure. The in vitro studies were implemented under different combinations of HIFU treatment intensities and laser power. The temperature increase was recorded with a high sensitivity thermocouple. The experimental results demonstrated that the concurrent light illumination during HIFU could enhance temperature increase and pro-

vide a safe method to achieve minimal thermal damage for tumor ablation.

P1-21 Short-term HRV를 이용한 부정맥 검출 알고리즘

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Various studies have been conducted to detect arrhythmia. Many types of features acquired from ECG have been used and heart rate variability (HRV) is a robust feature since the RR-intervals are less affected by the noise. Some previous studies tried to detect arrhythmia only with HRV and represented high accuracy. However the studies calculated HRV from long term signal and it causes time delay. In this study, arrhythmia detection with short term HRV is tried. HRV is calculated for every 5 seconds. Six HRV parameter and heart rate are used for detection and the accuracy was 92.28%.

P1-22 집속 초음파의 노출량 측정 시스템

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한국표준과학연구원 의료측정표준센터

Firstly, exposure parameters considering the temporal and spatial characteristics are introduced for the medical use of focused ultrasound. Including the schematic measurement procedure of exposure parameters of ultrasound, a brief introduction of measurement system and related calibration of source and receiver are also introduced in this paper.

P1-23 주요 네트워크를 이용한 인간 뇌의 네트워크 분석

최용호, 권훈기, 김보현, 이종민
한양대학교 생체공학과

POSTER I

The human brain consists of a network, which characteristic of small-world. This network has highly connected regions, that communicates between different regions of the brain. For these regions to play an important rule is identified by recent studies. And then they form influential subnetwork with strong internal connectivity. In this study, we identify a subnetwork of human brain network using principal network, analyze each principal network. .

P1-24 영 유아 방사선촬영 보조기구를 이용한 피폭선량 측정 및 화질 평가

이도병[1], 김정훈[2], 박지은[1], 안도현[1]
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Chest Radiography for infants using X-ray is generally done at FID of 100cm with a supine position on the Table Detector. In Digital Chest Radiography applying AEC System, Radiation exposure dose and image quality were measured using 5yr Phantom in two measurement conditions of Chest AP position from 60kVp to 80kVp at FID of 100cm and Chest PA position on the Stand Detector from 90kVp to 120kVp at FID of 180cm. As a result, when based on 60kVp between ESD at FID of 100cm and ESD at FID of 180cm using ADCI, there had been decreases of 24.2 ~ 84.3% in 70kVp~ 120kVp. In the case of SNR, T6, RCS, hilum were measured for research, when based on the measured at 60 kVp with ESD, 18.1~ 46.7% were decreased in T6, 9.9 ~ 28.9% were decreased in RCS and 10 ~ 31.2% were decreased in hilum. Therefore it showed that ESD was decreased and SNR was maintained above the proper value when using ADCI.

Cardiovascular Engineering

P1-25 회전하는 콘 케비테이션을 이용한 인공 심폐기(in-Vitro)

김의찬, 최성욱, 박성민
강원대학교 융합시스템공학부

Developed a cone type CPB machine for high-speed rotation in the blood. We develop CPB that minimizes areas exposed by gas and can exchange sufficient oxygen. It forms cavitation between rotating cone-shaped contact area and blood and causes a wide vortex in the blood. We determine working condition and control condition to supply sufficient blood and oxygen, and evaluate effects on the body. Finally, smaller size and volume than existing oxygen generator can supply pediatric to blood and oxygen. Also that make us gain the basic data of small CPB.

P1-26 KLT 알고리즘을 이용한 코로트코프 사운드 노이즈 제거 및 자동 혈압 추정 알고리즘

홍성준, 송수화, 이은혜, 이종실, 김인영
한양대학교 생체의공학과

Blood pressure is one of the most important indicators in the evaluation of the cardiovascular disease such as hypertension. The auscultatory method is the gold standard for the non-invasive blood pressure measurement. However, there is a lot of problem of automatic Blood Pressure detection using Korotokoff sound such as environment noise and motion artifacts. In this study, we propose new method for Korotokoff sound noise reduction algorithm and automatic Blood Pressure detection algorithm.

P1-27 중환자실 환자의 심박변이도 분석을 통한 심실부정맥 사전예측

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Ventricular tachyarrhythmia (VTA) is main cause of sudden cardiac death (SCD) and is divided into ventricular tachycardia (VT) and ventricular fibrillation (VF). Heart rate variability (HRV) reflects all symptoms associated with autonomic nervous system as well as heart disease. In this study, we tried to predict VTA earlier than 1-hour using HRV analysis and artificial neural network (ANN). This paper presents three models based on ANN to predict VT, VF and VTA (VT+VF). The ANNs showed an accuracy of 73.08% (57/78), 73.91% (104/142), and 86.11% (189/220) in VF, VT, and VT+VF, respectively. Early prediction of VTA, with such high accuracy as in the result, could improve mortality in SCD related emergency cases.

P1-28 3D 프린터로 제작한 핵의학 팬텀의 유용성

박효순, 이정표, 김갑중, 장혜원, 이태수
충북대학교 의용생체공학

We started this experiment to evaluate the usefulness of 3-D printed phantom, compared with the original phantom which is used to evaluate the function of gamma camera. After making the 3D computer graphics(3D-CG)model of the original phantom using CT scanning, we removed surrounding materials from the 3D-CG model, using the volume rendering technique. After editing the 3-D CG phantom model, we saved this information into the SD card and then test phantom was made using the converted STL file to G code file. Then we were able to acquire the same quality images of original phantom. So, we found that we are able to make a phantom through 3D printer. We expect that it will also be helpful to evaluate the functions of the various different machines such as MRI and CT by making phantoms through 3D printer.

P1-29 Wireless Power Transfer to a Pacemaker by using Metamaterials and Yagi-Uda Antenna Concept

Rupam Das and Hyoungsuk Yoo
School of Electrical Engineering, University of Ulsan

Wireless power transfer (WPT) to medical implants allows clinicians to avoid using bulky energy storage components. In this paper, we address WPT systems for a pacemaker (PM). A resonant inductive coupling method was employed in the WPT system by introducing a spiral transmitter (Tx) coil and a spiral receiver (Rx) coil. Here, we introduced the concept of the Yagi-Uda antenna by using metamaterials (MTMs) in order to increase WPT efficiency in the Medical Implanted Communication Service (MICS). Based on the simulation results in a realistic model of the human body, we were able to design a compact and efficient WPT system for PMs. Moreover, our simulation results showed that the Yagi-Uda antenna configuration can significantly increase WPT efficiency.

P1-30 Wireless Power Transfer and Biotelemetry in a Leadless Pacemaker

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In this paper, we address the telemetry and wireless powering problems associated with the recently invented leadless pacemaker. To overcome the

telemetry problem, we propose a conformal spiral type Implantable antenna at Medical Implanted Communication Service (MICS) band. In addition, we also apply the recently proposed midfield wireless power transfer (WPT) technique at 1.5 GHz to avoid the bulky energy storage component. We simulate and experimentally measure the performance of the implantable antenna by using porcine heart tissue. Our research shows that, the implantable antenna and wireless power transfer scheme can be implemented in a leadless pacemaker without any significant coupling between them.

P1-31 3D 프린팅을 이용한 심방중격결손 시술에 대한 계획

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Atrial septal defect (ASD) is a congenital heart defect in which blood flows between the atria of the heart. Normally, the atria are separated by the interatrial septum. It comprises 8~10% of all congenital heart diseases. Methods of closure of an ASD include surgical closure and percutaneous closure. The Amplatzer Septal Occluder is commonly used to close ASDs. In this study, 3D printing technology was used for surgery planning of ASD. Volume rendering technique was used to visualize the ASD and remove the surrounding tissues. 3D computer graphics model of ASD was made and stored as STL file and transformed to G-code file at SD card, and used to make the ASD model by 3D printer. 3D printed atrial septal defect model enabled surgery planning, through which the size and location could be decided before the closing procedure.

P1-32 초음파 이용 경동맥의 상대적 내막두께 측정기술 개발

김원식[1], 배장호[2], 김용태[1], 안봉영[1], 노기용[1]
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The common carotid artery consists of intima, media, and adventitia. In diagnosis, we can measure only the intima?media thickness (IMT), which is the sum of intima thickness (IT) and media thickness (MT), because the limitation of axial resolution of diagnostic ultrasound. To examine the echo width of superposed echoes is proportional to IT, we tried theoretical, experimental, and clinical approaches. In conclusion, the echo width is proportional to the IT for adults asymptomatic in cardiovascular disease, and can be regarded as relative IT. By measuring the relative IT, we can decide the main reason of abnormal increase in IMT.

P1-33 환자감시장치의 성능평가 기준 마련 연구

김산[1], 황윤수[1], 이선연[1], 박상건[1], 윤순종[2]
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Since International Electrotechnical Commission (IEC) enacted complete revisions of general standard (IEC 60601-1, 3rd Edition) and particular standard (IEC 60601-2-49, 3rd Edition) to enhance safety of Medical Electrical equipment(ME equipment), a harmonized international standard for evaluation of basic safety and essential performance on medical device has been required. However, domestic standards corresponding to the 3rd edition for performance evaluation of patient monitor has not been established yet. This study is, therefore, intended to research the authorization status and domestic/inter-

national market of patient monitoring devices and to suggest the test items, criteria and method for performance evaluation by examining the latest domestic/international standards in order to establish the test method. Through this study, the performance assessment method was prepared by verifying the actual products on the derived performance test items which are internationally harmonized and suitable for domestic circumstances. The assessment criteria established in this study is expected to be applied to licensing affairs as a standard and to be helpful in improving quality and safety of products by providing convenience to medical device industry in future.

P1-34 Moving Actuator를 이용한 자동 심폐 소생시의 성능 평가

강성민, 김의찬, 김동선, 최성욱
강원대학교 융합시스템공학과

The cardiopulmonary resuscitation (CPR) devices currently on the market reportedly have complicated structures and low pressure frequency. To solve these problems, this study combined BLCD motor and ball screw to manufacture moving actuator. It is measured to assess that the pressing force and time of battery consumption by in-vitro. The maximum compression force was measured at 69kgf and the time of the battery consumption was measured as 40 minute when pressure 120 times per minute. In this study was to evaluate the performance of the CPR device, by measuring the compression force and the battery consumption time of the developed CPR device.

P1-35 협착된 혈관에서의 재순환 혈류유동에 대한 수치해석

전성훈[1], 이덕희[1], 신연수[1], 손호성[1,2], 선경[1,2]
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[2]고려대학교 의과대학 흉부외과학교실

In this study, we performed statistical analysis on a stenosis model with degree and eccentricity of stenosis as the variables. The degrees of stenosis were 30%, 50%, and 80%, while eccentricity was set to 0, 0.33, 0.77, and 1. Higher degree of stenosis resulted in increased flow velocity and increase the length of recirculation area. Additionally, eccentricity increased the length of recirculation area when degree of stenosis was constant. We hypothesize that low flow velocity in recirculation area will cause deformation of epithelial cells, increasing the likelihood of thrombogenesis.

Orthopedic and Rehabilitation Engineering

P1-36 3차원 깊이 정보를 이용한 안면 편마비 증상 심도의 객관적 측정 방법 연구

유승민, 김도현, 이종실, 김인영
한양대학교 의생명공학전문대학원 생체의공학과

The prognosis of Bell's palsy and Ramsay Hunt is dependent on the degree of facial paralysis, slight paralysis can be recovered easily, but serious paralysis is hard to be recovered. Therefore, the objective assessment is important to determine proper treatments. In this research, we use the Kinect device to extract and track the facial feature point in order to assess the severity of facial palsy.

P1-37 단일 가속도계를 이용한 보행 거리 분석 시스템 개발

이기혁, 강신일, 조재성, 이종실, 김인영
한양대학교 의공학교실

In this paper, we present the development of gait distance analysis system using single accelerometer.

POSTER I

We measure acceleration of gait and calculate it using double integration method. From measured value, we can analysis gait cycle that have two patterns(Stance phase, Swing phase). Then we calculate gait distance without accumulated error using acceleration/velocity calibration method.

P1-38 하지 절단환자의 보행의도 인지를 위한 웨어러블 근전도 측정 시스템

박장호, 임채영, 김현우, 정하중
전자부품연구원 메디컬 IT 융합연구센터

Recent study on powered lower-limb prostheses has shown that electromyogram (EMG) signal of the thigh muscles is critical to recognize patient's gait intention. However, traditional electrodes cause various difficulties in clinical settings. In this study, we developed wearable EMG measurement system using textile electrodes. The bipolar electrode pair was designed to lay on the distal quadriceps to detect muscle activation by user's gait, and obtained EMG signal including muscle activation parameters are transmitted to integrated control module of powered leg via Bluetooth communication. EMG signal and activation time/pattern of thigh muscles during subject's gait showed reliable results. We expect that our proposed system could contribute to further research on the control of powered leg in the field conditions.

P1-39 Single-channel EMG 신호를 이용한 기본적인 팔의 움직임 분류

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[1]GIST 의료시스템학과, [2]GIST 기전공학부

Recently, many human motion tracking methods for rehabilitation have been reported. There are various tools in order to measure the human motion.

Among them, electromyography (EMG) is one of the powerful tools to detect human motion. The proposed method classified three fundamental movements of the human arm using the single channel EMG at the biceps brachii. The fast fourier transform (FFT), rectification, and smoothing filter are performed for extracting features. After the Linear discriminant analysis (LDA) applied for classification, the classification result shows that the EMG is useful tool for tracking the human motion.

P1-40 Focal adhesion complex 억제를 통한 연골세포의 탈분화 조절

신현준[1], 정진승[1], 이미남[1], 김상희[2], 최병현[3], 신현정[1]
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Multiplication of autologous chondrocytes in vitro is performed for insurance of sufficient populations in tissue engineering therapies. However, chondrocytes cultured in 2D monolayer in vitro lose intrinsic characteristics and change to fibroblast-like cells with increasing passages. In this study, we investigate the cellular changes including morphology, motility, and gene expression, as well as the role of focal adhesion during chondrocyte dedifferentiation. We found the inhibition of focal adhesion kinase (FAK) suppresses the progression of dedifferentiation and the recovery of chondrogenic characteristics.

P1-41 안정화 운동 시 전신진동기가 체간 근육 활성도에 미치는 효과

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The aim of this study is to compare the activity of the trunk muscles when the bridging exercise mainly

used for increasing the trunk stability in clinic research is implemented on the unstable surface and on the whole body vibration. A group (n=16) carried out the bridging exercise with supine on the unstable surface and B group (n=16) carried out the bridging exercise with supine on the whole body vibration. The surface electromyography was used to measure the muscle activity of the trunk muscles (rectus abdominis (RA), external oblique (EO), internal oblique (IO), multifidus (MF) and erector spinae (ES)). All of the muscle activities were greater on the whole body vibration than on the unstable surface during the bridging exercise. The whole body vibration can be utilized as the bridging exercise program intervention used in the exercise method of the trunk stability in clinical research.

P1-42 운전자세에 따른 요통 예방을 위한 체압 분포 피드백 시스템 개발

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Low back pain is usually caused by unbalanced body postures during driving. Although many massage systems in the car seats have been introduced in the market to resolve the low back pain, the information about the body pressure distribution of the drivers has not been considered for the accurate feedback massage systems. In this study, we developed body pressure distribution feedback system to prevent low back pain for possible sonic vibration massage system in the car seats. The results showed that the distinction of the body pressure distribution of the five driving posture and the balance of body pressure. This developed feedback system may give valuable information about the body pressure distribution to the drivers who has unbalanced posture during driving and help for designing smart balancing car seats as well as massage systems in the automobiles.

P1-43 운전자의 선호자세와 자동차 시트 설정 변수 간의 상관관계

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Positioning system of car seat has improved by researching driving posture at the ergonomic point of view. Some studies have tried to find the most preferred driving posture for evaluating comfortable car seat. In this study, preferred seat conditions and the driving postures of 40 participants were measured, and their correlations were analyzed. Especially, there was significantly positive correlation between not backrest and lower limb angle but backrest and upper limb angle.

P1-44 발등굽힘에 사용되는 하지 근육의 전기 자극 전후 근전도 비교

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Electromyography is simple and easy to record from the muscles activated. However it is not easy to analyze and interpret the measurand quantitatively because of inter-and intra- individual difference. Maximum voluntary contraction (MVC) is often, therefore, measured and used for the normalization. Similarity Index (SI) might be used without MVC normalization because SI is based on the total EMG activities of muscles involved during a certain maneuver. We evaluated SI changes pre and post electrical stimulation on muscles used for dorsiflexion of the ankle. Fourteen healthy subjects participated. Electrical stimulation on the ankle flexors was given for up to 15 minutes using the self-selected electrical intensity. SI were measured from multi-muscles and

compared. As a result, the muscle strength of flexor, the magnitude of EMG and SI were significantly decreased after electrical stimulation. In conclusion, electrical stimulation on flexors of the ankle may change the magnitude of EMG, muscle strength and SI values.

P1-45 Silicone과 PVA-H로 만든 혈관 바이오 모델을 이용한 중재적 의료 기구의 Track-ability에 관한 기초 연구

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Endovascular treatments using catheters for cerebral aneurysms have been widely accepted as a less invasive way. In this paper, we investigated the parameters with effect traceability to assess the mechanical properties of interventional devices. Trackability depends on the performance of the interventional devices in order to pass through the curved part of the model simulation track. The traceability of the guide wire was found to be much better than that of the balloon and stent loading catheter, as it reached the aneurysm sac in both phantom models.

P1-46 동적 하네스 시스템 개발을 위한 일상생활 동작 인체패턴 사전연구

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The purpose of this paper is to analyze human body pattern for verifying developed active harness control system. The active harness control system is designed to prepare outbreak situation and help eff-

ective rehabilitation training for gait and posture balance. The experimental procedure is designed to do ADL (Activities of Daily Living) both consecutive and distinction action of each task. The experimental procedure has been validated on five healthy subjects using EMG and Foot Pressure. EMG patterns for each task are to verify user intension detection system. Foot Pressure results demonstrate function of body weight support (BWS) by active harness system.

P1-47 근골격계 인체모델링을 이용한 극돌기간 임플란트와 유합 임플란트의 요추 관절 각과 관절력에 미치는 영향 해석

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The aim of the study was to investigate newly designed interspinous process (ISP) implants using musculoskeletal modeling. Two musculoskeletal models with ISP and fusion implants were developed using the AnyBody Modeling System. About 22 % of motion for the ISP implant ($3.57°$) and 34 % of motion for the fusion implant ($3.02°$) at the L4-L5 level was decreased from the normal case ($4.59°$) during the 30 degrees of thoracic-lumbar motion. On the other hand, only 2% of joint load on L4-L5 was increased from the normal case but about 29 % of load was increased for the fusion case.

P1-48 보행의지파악을 위한 경사환경별 족부압력 분석에 대한 연구

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The purpose of this study was to analyze the foot pressure for estimating intention detection of gait

during slope condition with rollator. We measured the foot pressure (force, mean pressure) using Pedar-X system. Twenty healthy volunteers (age 24.3±1.5 years, height 174.7±5.3 cm, weight 75.6±4.6 kg) participated in this study. Foot pressure results showed significant increase according to the gait slope and velocity. We suggest that the increase of the rearfoot pressure in the anterior tilt including increase of forefoot pressure in the posterior tilt.

Respiratory Engineering

P1-49 비강압력 신호와 광용적맥파를 이용한 심폐결합 분석 기반의 수면 평가

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This study proposes a cardiopulmonary coupling (CPC)-based method for automatic assessment of sleep quality in patients with sleep apnea-hypopnea syndrome for continuous positive airway pressure (CPAP) device. CPC was induced from nasal pressure (NP) respiration and normal-to-normal interval series of photoplethysmogram (PPG). We conducted the statistical analysis between CPC parameters and PSG indices. Compared with high frequency coupling (HFC), apnea hypopnea index (AHI) and arousal index (AI) were significantly decreased and sleep efficiency (SE) was significantly increased. On the contrary, compared with low frequency coupling (LFC), AHI and AI were significantly decreased and SE was significantly increased. Also, CPC parameters show a significant difference between the Low SE (〈85%) and the High SE (≥85%) as well as among the sleep disordered breathing (SDB) severity. Therefore, this method has the potential to assess the sleep quality and the SDB severity for CPAP device.

P1-50 맞춤형 흉막압력 측정 장치의 개발

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Normally, the lung wants to collapse and the chest wall wants to expand. It's coupling of the pleurae that keep the lung and chest wall moving together. It's important to know how to enhance beneficial pressure changes for patients. In this paper, a customizing device for measurement of pleural pressure was developed. To evaluate the performance of the device, our device is better as compared with digital pressure meter. Since the developed system can be specific and quantification. This promises that the system can be used not only in cardiac field but also in respiratory physiology studies.

P1-51 심전도 유도 호흡의 동역학적 특성을 이용한 입면 지연 시간 추정 방법

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In this research, we developed an algorithm to estimate sleep onset latency (SOL) using ECG-derived respiration (EDR) dynamics. Respiratory signal was acquired from R-R intervals measured from a patch-type sensor during nighttime PSG. Respiratory frequency was calculated in 30 seconds (1 epoch) of the data. Sleep onset was found when the respiratory frequency is maintained for 3 continuous epochs. 10 subjects participated in this study. As a result, it showed that 1.85 minutes of mean absolute error between reference SOL from PSG and estimated SOL based on the proposed method.

POSTER I

P1-52 응급 상황에 사용이 가능한 호흡기류센 서의 유효성 평가

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The present study aimed to validate the respiratory air flow transducer developed for emergency applications such as cardiopulmonary resuscitation or artificial ventilation in the intensive care unit. Four signals were generated by the standard flow generation system to simulate the air flow signals under artificial ventilation with similar waveforms. The tidal volume were obtained by integrating the flow signals measured by the transducer, then compared with the accurate volume provided by the displacement transducer of the flow generator system. The relative errors between the standard and the measured volumes were within 3% with less than 5% error in the maximal flow rate. Therefore, the respiratory air flow transducer was validated for emergency applications with good enough accuracy.

U-Health, e-Health. m-Health Technology

P1-53 비디오투시 영상에서 자동 설골 추정 프로그램 구현

이준창, 김희평, 황종호, 윤정민, 안지민
윤성훈, 김주영, 안현준, 김인영
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Dysphagia is a swallowing disorder caused by various pathologic conditions in neurologic disease patients. Early detection and proper management is necessary for dysphagia. Videofluoroscopic swallowing study (VFSS) is conventionally considered the standard for evaluation of patients with swallowing disorders. In clinical practice, clinical doctors manually evaluate the movement of the hyoid bone of the patients whilst adjusting for their head movement. This would induce unnecessary fatigue to the doctors which may even affect the accuracy of the evaluation. In this paper, we demonstrate a program that automatically evaluates the hyoid bone motion from VFSS of patients with swallowing disorders.

P1-54 R-R interval의 표준편차와 Support Vector Machine을 이용한 실시간 심실 세동 감지

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This paper presents an approach to classify normal and atrial fibrillation (AF) in real-time from the simulation ECG signal using support vector machine with the standard deviation (SD) of RR-interval served as the feature of SVM. We detected atrial fibrillation with 100% classification from 2 or more RR-interval sample. Furthermore, we confirmed that the differences of the feature of normal and AF were shown to be clearly when the features were calculated from many RR-interval samples.

P1-55 단열성 덮개의 종류에 따른 피부체온 변화양상

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Skin temperature relies on the interaction between the endogenous thermal environment of human and the ambient thermal environment. Especially, within the change of ambient temperature, monitoring a change of skin temperature induced by the endogenous thermal environment is difficult. Therefore, the control of external environment is important to study the internal change of physiological pheno-

mena. This research shows that the significant change of skin temperature that properly reflects the change of the core temperature, using simulation test. We tested how the skin temperature could reflect the internal thermal changes in the cases without and with the insulated covers, and with air layers between the cover and skin.

P1-56 광용적맥파의 다양한 특징점을 이용한 혈압 추정

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The purpose of this study is estimation of blood pressure using various features of photoplethysmography. Extracting the 16 characteristic point of the PPG data collected by signal processing. Using that feature points, we can derive the multiple linear regression equation to estimate blood pressure just through PPG. The estimated coefficient of determination of systole and diastole blood pressure by various feature points, is 0.823 and 0.343 respectively. The error rate of them is 9% and 33% respectively.

P1-57 CPAP 적정압력 평가를 위한 파라미터 도출

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In this study, parameters were extracted to assess the optimum pressure based on the pulse rate variability (PRV) during the CPAP titration. PRV was calculated from the photoplethysmography (PPG) signal in the three different regions with and without the CPAP titration. Seven features (PP, SDPP, RMSSD, VLF, LF, HF and LF/HF ratio) were extracted from the PRV based on time and spectral analyses.

Eighteen patients with OSA participated. Statistical analysis was performed for all features between with and without CPAP titration regions. The result showed that SDPP and HF are the most significant features of the optimum pressure during the CPAP titration.

P1-58 기계학습을 이용한 졸음 검출 예비 연구

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Drowsiness during driving is a serious problem and is related to car accident. Previous studies of drowsiness detection by EEG signal used multi-channel EEG. However, there are not much research about real-time drowsiness detection using 1 channel EEG. This study aims to confirm the possibility of detecting drowsiness using 1 channel EEG by machine learning methods. First, we calculated power spectrum density by Fast Fourier Transform and then divided into 4 standard EEG frequency bands. Second, parameters were extracted from each frequency band. Using extracted parameters, drowsiness and wake data were classified by machine learning methods. This process was repeated with 1-15s time window size. The best classification accuracy was 79.9%.

P1-59 광잡음 제거를 통한 원거리 광용적맥파 성능 개선-사전 연구

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Camera based remote photoplethysmography (rPPG) enables easy-to-use, noninvasive, and non-contact cardiovascular monitoring. Due to the light variation in real life, the light artifacts occur in applying rPPG

to practical application. In this paper, we proposed a curve fitting model to remove the light noise, and we compared each performance of various models. We calculated the root mean square error (RMSE), and signal-to-noise ratio (SNR) from the models of which order is from first to ninth. There were significant difference between subjects, but no significant difference was observed between the models.

P1-60 비접촉 바이탈사인 측정이 가능한 E-Health 거울의 개발

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Our e-health mirror is part of ubiquitous health-care device which measure and monitor vital signs in human body without physical contact between user and the device. Three primary vital signs has been measured i.e. heart rate (HR), respiratory rate (RR), and body temperature (BT). We use one-way mirror to build this system. In back-side, we attach sensors, microcontroller, processors, and LCD monitor. On front-side, the results of measurements are displayed. BT, HR, and RR are measured by using digital camera based on remote Photoplethysmography (PPG). For measuring BT, we use Infrared thermometer i.e. MLX90614 were measured in distance between 30 ~ 100 cm. Both of it has average error around 2 bpm. In distance between 30 ~ 100 cm, BT measurement has error around 1 ~ 3°C. The closer the distance between user and sensor, the more accuracy of BT measurement

P1-61 다중회귀분석을 이용한 심박 기반의 일주기 체온 리듬 추정

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Body temperature is one of the physiological signals that reflect individual biological clock. However, current body temperature monitoring methods are not suitable for daily life application. Therefore, we proposed the circadian body temperature rhythm estimation based on heart rate observations via multiple regression analysis. Core temperature and heart rate dataset acquired from eighteen subjects were used and as a result, RMSE was 0.35°C and bias was 0.11°C. We expect that this approach can be helpful in monitoring circadian body temperature rhythm in daily life and treating related health problems such as insomnia, and altered hormonal function.

P1-62 공압 시스템을 이용한 원격의 링거 투여량 정밀 제어 및 관리

김현우, 박주용, 허정현, 김진우, 윤영로
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The existing ringer injection control system entirely depends on manpower. So it can cause medical accident. Therefore we suggest remote patient's status monitoring system and ringer injection control system. In this study we developed ringer injection control system using pneumatic model. To measure ringer's weight variation, we select 10kg loadcell with 24bit adc sensor. For control of ringer's injection and monitoring, we developed android application program. We expect this system can promote the convenience of the health care workers and provide medical care and reliability.

P1-63 커프를 활용한 맥파 측정 시 말단 신호의 유의미성 평가

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This study is a prior study for system design for

evaluating the small area's atherosclerosis. For this purpose, we evaluate the effectiveness of the terminal pulse wave while putting pressure on the biceps. Using mercury sphygmomanometer we put pressure on the biceps and using PPG with biopac we measure the terminal pulse wave. Comparative analysis of the signals obtained while varying the pressure to give a result of PWV 579.84~626.77cm/s SD 17.06cm/s. Therefore it is necessary to evaluate of the small area's atherosclerosis.

P1-64 얼굴 영상 기반 원격 혈관용적파 추출 시 최적의 신호 추출 기법

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As wide spreading of camera-equipped devices to the daily living environment, there are enormous opportunities to utilize the camera-based remote photoplethysmography (PPG) for daily physiological monitoring. In the camera-based remote PPG (rPPG) monitoring, the region of interest (ROI) is high related to the signal quality for the signal extraction processing. In this study, we proposed rPPG extraction methods from a facial video and compared them in terms of the signal quality. The results showed that the signal extracted from the original region detected by a face detection algorithm had relatively worse quality. The signal extracted from the high correlation area with the face-only region showed the best quality.

P1-65 단일 채널 뇌전도 기반 개인 인증 성능 평가

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We composed Electroencephalography (EEG) based person authentication system measured during resting-eyes-closed state. Regarding practical use, we evaluated the performance of authentication system assuming that only single channel is used in the system. We measured EEG 32 channels in 10-20 system and performance for each channel is presented. The authentication system is composed of 4 steps. First is acquiring 30 trials of training data from 20 subjects. Second is extracting features, in this case we applied power spectrum extracted between 2-40Hz with 0.5Hz resolution. Thirdly, we measured EEG with same protocol in different days to apply as test data. Lastly, we classified based on Bayes classifier. The performance was evaluated by calculating false acceptance rate, false rejection rate. The best performance was using Fz channel with FRR 15.85%, FAR 12.71% and HTER 14.28% respectively.

P1-66 자동 잡음 제거 및 피크 검출 알고리즘의 성능 비교평가

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In the capacitive ECG measurement system, handling noisy signal is one of the most important process. Recently we developed automatic noise removal and peak detection algorithm for ECG measured from capacitively coupled electrodes. In this study, we validate performance of developed algorithm by comparing to one of traditional peak detection algorithms. Proposed algorithm has relatively large number of false negative error beats because it tends to detect only confident R peaks. However according to its careful noise removal process, it represent more stable performance under real experimental condition which includes various type of ECG disturbance factors.

POSTER I

P1-67 요로감염진단을 위한 모바일 기반 요시험지봉 검사기 개발

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Recently, smartphone has been alternatively used for imaging colorimetric tests to easily acquire consistent analysis. In this study, we developed a mobile-based urine reagent strip test device for quickly detecting leukocytes esterase (LEU) and nitrite (NIT) in the urine, which are important factors for diagnosing urinary tract infection (UTI). Notably, we also evaluated the proposed device with clinical urine samples from patients (n=57) who visited the emergency department, and compared the results with those of another urinalysis analyzer (US-3100R Plus®) used as references. The proposed device showed high accuracy (87.7% for LEU and 98.3% for NIT) and significantly reduced turn-around time of analysis (median time: 3.0 min of the proposed device versus 37.0 min of US-3100R Plus®).

P1-68 호흡과 움직임 신호를 이용한 무구속 4단계 수면 분석

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Polysomnography (PSG) is a gold standard method for sleep stage scoring. However, in PSG recording, a large number of electrodes are attached to the subject's face and specially trained sleep experts are needed. For accurate and daily sleep stage monitoring, we used respiration and body movement signal from PVDF-based sensor for analysis. Twelve healthy subjects and thirteen OSA patients participated in this study. For every 30 seconds, REM sleep, deep sleep, and wake epochs were determined based on the suggested conditions. For epoch-by-epoch detection, the method classified sleep stage with an average accuracy of 71.3%, and kappa statistic of 0.48.

P1-69 무선 동맥경화도 진단 시스템의 개발 : 심전도 전극 일체형 커프를 사용한 심전도 및 맥파 계측 시스템

임지현, 이정직, 조은일, 한지호, 이재훈, 윤영로
연세대학교 의공학과

The purpose of this study is measuring ECG (Electrocardiogram) and Pulse wave using self-production cuff integrated with ECG electrode. It is pilot study for making wireless arteriosclerosis diagnostic instrument. The electrodes made of electrical woven fabrics measure ECG and cuff measures Pulse wave. By wearing the self-production cuff on the four limbs, one ECG and four Pulse wave are obtained. Acquired bio-signals are processed and transmitted to PC software to display using bluetooth.

P1-70 수액잔량모니터링 시스템 임상적용 및 유효성 관찰

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In the study, we developed the ringer monitoring system for nurses and evaluated clinical effectiveness of the system. The ringer monitoring system, consisting of a weight measuring unit and a monitoring system. The weight measuring unit monitors the remaining volume of fluid and the monitoring system, located in nurse station, collects the information of

all installed weight measuring units and reports nurses about the patient who need to remove the ringer. For the clinical evaluation of the effectiveness, 27nurses were recruited and using the system for 15days. The results showed tendency to decrease the number of times being monitored.

P1-71 얼굴 영상 기반 비접촉식 혈중 산소포화도 측정 기술에 관한 선행 연구

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In this study, we developed contactless method of estimating peripheral oxygen saturation (SpO^2) level within tissue, based upon facial video monitoring under ambient light condition. Resting state of facial video was used to estimate SpO^2 level using standard DSLR camera. No additional LED source or photodetector were used to measure blood oxygen level. We used ratio of ratios method to estimate the SpO2 and red and blue channels are selected for source signals. We confirmed the accuracy of measurements of heart rate and blood oxygen saturation, by comparison to commercial pulse oximeter. The correlation between estimated oxygen saturation level and reference signal was 0.75.

P1-72 스마트폰을 이용한 파킨슨 환자의 보행동결 증상 진단

김한별, 이홍지, 이웅우, 권성준, 김상경
전효선, 박혜영, 신채원, 이원진, 전범석, 박광석
서울대학교 협동과정 바이오엔지니어링

Freezing of gait (FOG) is one of the most common motor impairments from Parkinson's disease. The main symptom of FOG is an inability to walk during gait, even with willingness of patients. Smartphone can detect FOG by utilizing built-in motion sensors, such as accelerometer and gyroscope without additional devices. In this study, we developed unconstrained system based on single smartphone and classified FOG with machine learning algorithm. The performance showed 75.3% sensitivity, which is 10% higher than conventional algorithm and specificity of 92% in average.

P1-73 혈역학 에너지 측정을 위한 복합 생체 모니터링 시스템 연구

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This study aimed to integrate multiple monitoring devices into a single device, while also incorporating hemodynamic energy monitoring. Blood pressure and flow were measured with two channels each, while electrocardiogram, photoplethysmography, and temperature were measured with one channel each. The seven signals were then converted into digital signals with a data acquisition board. The software was developed with Labview™ to form a graphic user interface on a tablet computer through USB 2.0, to allow for monitoring and analysis of the signals obtained. Development of this system successfully formed a multi-signal monitoring system that integrates multiple signals into one device.

P1-74 자전거 운동 중 하체에 작용하는 힘과 에너지소비량과의 관계

최우혁, 김태균, 엄영일, 신태민
연세대학교 보건과학대학 의공학과

This study aims to investigate the influence of force exerted of lower body on estimation of EE during an incremental bicycle exercise. We tested

using the module which was combination of acceleration and force sensor and was placed inside the pedal to represent lower body workout. In conclusion, findings from this study indicate that the estimation of EE considered the acceleration and the force exerted of lower body by pedaling is more accurate and efficient during bicycle exercise.

P1-75 스노우보드 시뮬레이터 운동 시 하지 운동특성 분석 및 패턴 변동성 파라미터를 이용한 숙련도 평가

안순재, 박선우, 최은경, 김종만, 차백동, 김영호
연세대학교 의공학과

In this study, joint angles of the lower extremity were measured during a snowboard simulator exercise in order to evaluate the skill of snowboarders. Ten experts and twenty unskilled snowboarders were recruited for the study. A three-dimensional motion capture system were used to acquire joint movements during snowboard simulator exercises. Pattern variation values were calculated to assess the variations in the snowboard simulator motion of expert and unskilled snowboarders. Results showed that snowboard experts showed greater range of motion of joint angles than unskilled snowboarders. Snowboard experts also showed smaller pattern variations than unskilled snowboarders. Pattern variations parameters during the snowboard simulator exercises could be useful to evaluate the skill of snowboarders.

P1-76 강한 잡음 환경에서 골전도 음성신호의 웨이블릿 패킷 영역 적응필터에 기반한 음성신호 잡음 제거 방법

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In this paper, we proposed the noise cancellation method of BC(Bone-Conduction) speech based on wavelet packet decomposition and adaptive filter. The AC(Air-Conduction) and BC speech signals decomposed by wavelet function to extract the speech bands from BC speech signals. The adaptive filter was used for noise cancellation of resynthesized AC signal. The noise of other frequency bands except for the resynthesized AC signal is removed by the gate which is created using the entropy of BC signal.

P1-77 무구속 심탄도 모니터링을 통한 폐쇄성 수면 무호흡 구간의 검출

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Obstructive sleep apnea (OSA), characterized by recurrent cessations or substantial reductions in breathing during sleep, is a prevalent and serious medical condition. Undiagnosed and untreated OSA is a risk factor for life-threatening complications. This study aimed to suggest a method for detecting OSA through unconstrained ballistocardiogram monitoring. We hypothesized that sleep apnea- and hypopnea-related hypoxia or arousals would cause unstable parasympathetic nervous activity. Based on the hypothesis, the coefficient of variation of spectral array in heart rate variability high-frequency band was used to determine OSA. Our method may address the growing need for a reliable and simple OSA diagnostic tool.

P1-78 온열 및 영상자극으로 부여한 스트레스가 심박변이도에 미치는 영향

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Purpose this study is to find the status of autonomic nervous system stress by thermal and video stimulus on Heart Rate Variability (HRV). To measure stress according to thermal change, we divided thermal in 3 conditions and video stimulus in 4 conditions. Through this study, we made the stress index. The stress index was incresed by thermal and video stimulus level increase.

P1-79 액상세포 검사용 검체의 적정 농도 구현을 위한 광학 기반 농도 측정에 관한 연구

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[3]전북대학교 고령친화복지기기연구센터, [4](주) 패스텍

When the liquid cytology was too much or less, steping on slide glass was overlaps or lack. So the appropriate amount of clinical specimen mixed sample is needed. Picture image of the solution had been obtained by the optical method to ensure correcting Sample of appropriate concentration. Using the obtained image was developed an algorithm that derives the brightness values using a Matlab. When the concentration was high it closer to the dark 0, and the concentration was low it close to the bright 1.

P1-80 보행 안정성 향상을 위한 체성감각자극이 지면반발력에 미치는 영향에 대한 연구

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Gait requires balance and the roles of visual senses, vestibular system and somatosensory system are important to maintain postures. Also, Gait is a voluntary movement that requires interactions between sensory, muscular and central nerve systems. Therefore, gait disorder may improve by using the external stimulus on sensory system. Using the results of the analysis, we realized a model that detects gait cycle and abnormal gait and applies proper somatosensory stimulation using a small 3-axis movement sensor. The results showed changed ground reaction force, which was considered that local somatosensory stimulation gave immediate feedback and changed the characteristics of gait during the gait.

P1-81 유기용제에 노출된 직업군에서 보여 진 작업 기억에서의 인지부하에 따른 신경학적 변화

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Organic solvents are known toxic effect like vertigo, behavioral obstacle, distracting, and peripheral neuropathy in neuron area. However, there have been few studies how neurotoxic solvents-exposed workers are affected by the cognitive load of preceding working memory tasks. Therefore, we used fMRI as to measure the neural correlates of working memory impairment in occupational workers results from chronic exposure to organic solvent. Twenty-nine solvent-exposed workers were included in this study. Each participant concluded the verbal N-back tasks (1- and 2-back) during the fMRI acquisition. Within-group analyses showed fronto-parietal networks were active in each condition. Direct comparisons between 1- and 2-back showed higher activation during the 2-back than 1-back. We found that increased activation of these regions at lower task demand is associated with increased cost of implementing.

POSTER II

Biomedical Engineering Education and Career

Medical and Bio-informatics

Medical Imaging

System Biology, Physiological Modeling

POSTER II

Biomedical Engineering Education and Career

P2-01 피부선량 측정용 초박형 광섬유 방사선 량계의 제작 및 성능평가

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In this study, we fabricated an ultra-thin fiber-optic dosimeter using organic scintillator and optical fibers. The dosimeter measure skin dose and percentage depth dose in a build-up region for an incident high energy photon beam. In addition, using an ultra-thin fiber-optic dosimeter, GAFCHROMIC® EBT film and MCNPX simulation, skin dose and percentage depth dose in the build-up region are measured and compared.

P2-02 Dorsal Skinfold Chamber의 계층 구조에 따른 종양 이식 모델의 분석

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To acquire high resolution image of cancer cells and surrounding tissue environment, various imaging windows have been used for mice cancer xenograft model. Among them, dorsal skinfold chamber is widely used for angiogenesis studies in various cancer types due to its simple surgery and easy optical approach. Current researches with advanced imaging modalities suggests further application of dorsal skinfold chamber to investigate cancer invasion and metastasis. However, since anatomical structure of dorsal skinfold chamber is based on skinfold of mice dorsal region, tissue environment provided by implanted cancer cell is no consistent, but strictly distinguished along its anatomical location. Here, we suggest that dorsal skinfold chamber can be utilized to investigate tissue dependent cancer cell behavior analysis of implanted cancer cells by categorizing them in layer-dependent manner.

P2-03 표면 플라즈몬 공명을 이용한 신경세포 자극 연구

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Various methods for external stimulation have been employed to activate neuron cells. Electrical stimulation method has been mainly used due to quantification and controllability. However, it has the limitations of invasiveness and poor spatial selectivity. Optical stimulation has enabled a significant progress in modulating a neural activity because light can be delivered to the target area via artifact-free, damage-free and contact-free stimulation. In this study, we show that neurons cultured on a surface plasmon resonance (SPR) substrate can be stimulated by propagating surface plasmon waves. We measure the neural activities by visualizing in vitro neuron cells labeled with FM 1-43 fluorescence dyes.

P2-04 표면 플라즈몬 공명 센서의 감도 향상을 위한 2차원 금속-유전체 복합 나노구조

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For improving sensitivity of a conventional thin-film-based surface plasmon resonance (SPR) biosensor, metallic nanostructures have been utilized extensively. Metallic nanostructures such as nanograting, nanodisk and nanopillar may induce an amp-

lified electromagnetic field through localized surface plasmon resonance (LSPR). Nevertheless, several drawbacks such as broad and shallow reflectance curve and negative angle shift can be accompanied by using metallic nanostructures on a planar SPR surface. To overcome those drawbacks, we propose a 2D metal-dielectric hybrid nanopillar structure using a nanoimprint lithography. Dielectric layer between gold film and gold nanopillar is expected to contribute to prevention of a destructive interaction of propagating surface plasmons with LSPR modes by gold nanopillars.

P2-05 확산광 단층영상 시스템의 구축 및 검증

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광주과학기술원 [1]의료시스템학과, [2]정보통신공학부

Diffuse Optical Tomography (DOT) is a non-invasive method to acquire functional images by using near-infrared range light. DOT could be used to monitor the effectiveness of breast cancer therapy. Compared to the current standards mammography which is painful and provides only morphological images, DOT is non-ionizing and provides hemoglobin concentration information. The main goal of this work is to develop DOT system for acquiring two-dimensional absorption images, and validate this system by using optical phantoms. The results show a clear distinction depending on the absorption characteristics. These preliminary results show the possibility to distinguish between normal and tumor tissues.

P2-06 뇌 혈류와 산소포화도 동시 측정을 위한 비접촉식 확산 스페클 대조 분석-확산광 분광기 융합장비 개발

Zephaniah Phillips V[1], 성명수[2], Phuong Minh Mai[1]
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In human body, both blood flow and oxygenation are very important factors in maintaining life and proper functioning the body parts. To study blood oxygenation and flow in small animal, we tried preliminary measurements using a noncontact combined diffuse speckle contrast analysis-diffuse optical spectroscopy on a human palm during cuff occlusion and on small animal brain during hypercapnia with 7.5 % of CO_2 gas. Arm cuff occlusion showed physiologically meaningful change in blood flow but not in hemoglobin change. In small animal experiment, the device failed to track any parameter during hypercapnia. We expect that the failure can be overcome after parameters optimization using a human tissue mimetic phantom.

P2-07 피부암 치료를 위한 초소형 X-선 튜브 어플리케이터 시스템

김현진, 라자 하미드, 김현남, 조성오
KAIST 원자력 및 양자공학과

Electronic brachytherapy is the administration of high dose rate (HDR) brachytherapy without the use of a radioactive isotope and with minimal shielding requirements because of its low energy source. This source may be turned on and off at will and can be operated at variable currents and voltages to change the dose rate and penetration depths. A vacuum-sealed miniature X-ray tube based on carbon nanotube was used as an electronic brachytherapy source. Miniature X-ray tube needs to X-ray collimator and filter to apply for skin cancer therapy as electronic brachytherapy. X-ray collimator and X-ray filter for skin cancer treatment were optimized using MCNP code. X-ray distribution and dose rate will be measured. After designing of collimator and filter. The proposed miniature X-ray tube will deliver uniform radial dose distribution to skin cancer therapy.

POSTER II

P2-08 수술현미경에서의 다중형광을 이용한 뇌 종양과 혈관영상 검출 시스템 연구

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In this paper, we propose a microscope system for detecting both a brain tumor and blood vessels in tumor surgery as fluorescence images by using multiple light sources and a beam-splitter module. The proposed method displays fluorescent images of the tumor and blood vessels on the same display device and also provides accurate information about them to the operator. To acquire a fluorescence image, we utilized 5-ALA (5-aminolevulinic acid) for the tumor and ICG (Indocyanine green) for blood vessels, and we used a beam-splitter module combined with a microscope for simultaneous detection of both.

P2-09 벌룬 카테터 응용 산광기를 이용한 기도 협착치료

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Photothermal therapy has limited efficacy and application due to difficulties in propagating light inside tissue especially in human body. In this study, we demonstrate the use of a novel balloon catheter-based diffusing optical device to treat tracheal stenosis. A 600 μm optical fiber was developed to achieve the laterally uniform light distribution by micro-machining the surface of optical fiber in order to effectively coagulate the targeted regions within the tracheal stenosis. Uniform pattern was engraved on the fiber surface using focused CO_2 laser beam at 5 W. Spatial emission of the fiber tip was visualized to validate the performance of the fabricated diffuser. For spatial characteristics, polar, azimuthal, and longi-

tudinal emissions were evaluated. The spatial emission characteristics of diffusing fiber presented an almost uniform power distribution along the diffuser tip and around its circumference. A visible wavelength (532 nm) combined with balloon catheter-based diffuser was used to thermally decompose tracheal tissue structure. By providing direct delivery of diffuse light to the target tissue while minimizing undesirable photothermal damage in the adjacent tissue, the proposed catheter-based diffuser can be a feasible therapeutic device to treat the tracheal stenosis.

P2-10 펄스 레이저를 이용한 신경세포의 활성 기술과 응용

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Femtosecond laser can induce chemical alteration in localized focus area due to its extremely high intensity. With femtosecond-pulsed laser, we investigated the abnormal condition of neurons induced by drug treatment. We found that laser stimulation increased intracellular Ca^{2+} level with different profile or induced neuronal cell death depending on delivered energy under $A\beta$ treatment. Our results collectively indicate that femtosecond laser stimulation may distinguish abnormal neurons treated with toxic drugs and healthy neuron through investigation on laser-induced responses, which may be further applied for drug screening at clinical study.

P2-11 닭 배아의 혈류검출을 위한 다채널 확산 스팩클 대비 분석 시스템 개발

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In poultry industry, early and accurate differentiation whether chick embryos live in the artificial

incubation periods or not is critical for reducing the financial resources. Here, noninvasive measurement of deep blood flow inside superficial layer of eggshell using a multi-channel diffuse speckle contrast analysis (DSCA) system coupled with four optical fiber detectors is proposed. The detection of vital sign of the chick embryos in early incubation stage is effectively achieved by the proposed system. The DSCA system with portability and low cost could be a practical approach enabling to examine the development of chick embryo.

P2-12　고분해능 내시경 광결맞음단층영상

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Optical coherence tomography (OCT) acquires three-dimensional microstructure of biological samples. In general, OCT has ~10 μm resolution in both axial and transverse directions, which is not enough to visualize individual cells and sub-cellular structures. High-resolution OCT with an improved spatial resolution up to 1 μm enables clear visualization of cellular and sub-cellular features of biological samples. An endoscopic probe for high-resolution OCT is vital to investigate internal organs in vivo. Therefore, we have developed a high-resolution endoscopic probe using a gradient-index (GRIN) lens and a high-resolution OCT system, using a broadband laser source.

P2-13　분광광간섭단층영상을 이용한 동맥경화반 검출

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Intravascular optical coherence tomography (IV-OCT) provides a high-resolution cross-sectional image of the arteries, but IV-OCT is not capable of characterizing compositional and biochemical features of atherosclerotic plaque. In this work, we developed an automated algorithm for characterizing atherosclerotic plaque composition using spectroscopic OCT (S-OCT), which provides spectroscopic information of the sample without any additional device. The sensitivity and the specificity was 90.5% and 91.7%, respectively, in a validation study using rabbit model of atherosclerosis. The complementary compositional information provided by S-OCT will allow for the better assessment of the high-risk atherosclerotic plaque.

P2-14　일회성 연성내시경의 조명효율 개선을 위한 광섬유 끝단의 형상 모델링 및 최적화 연구

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오송첨단의료산업진흥재단 첨단의료기기개발지원센터

We studied the method to improve the illumination efficiency for disposable flexible endoscopy. Using the LightTools software, we obtained the illumination efficiency increased by about 40% percent in the polished fibers more than in the unpolished fibers when LED was directly excited to fiber. We also showed the illumination efficiency changed by geometrical shapes in the end of fiber for the minimization of the Illumination loss.

P2-15　소동물 모델에서 뇌의 산소포화도 변화를 이용한 마취 후 각성의 조기예측

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배재관[2], 이보름[2], 김형일[2], 김재관[1,2]

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The awakening from anesthesia during a surgery can be a disaster for a subject, and yet the monitoring of anesthesia depth by BIS (bispectral index) needs to be improved. In this study, we observed

the oxygenation changes in the brain depending on the depth of anesthesia by using a combination of electroencephalogram (EEG) and near-infrared spectroscopy (NIRS). The preliminary result showed that cerebral oxygenation change may be able to early predict awakening from anesthesia.

P2-16 다 변량 분석방법을 이용한 인도시아닌 그린 형광 동역학 특징 추출 및 혈관계 질환 진단 방법

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Indocyanine green (ICG), a near-infrared fluorophore, has been used in visualization of vascular structure and non-invasive diagnosis of vascular disorders. We have recently developed a minimally invasive diagnostics system based on ICG fluorescence imaging for sensitive detection of vascular insufficiency. In this study, we used principal component analysis (PCA) to examine ICG spatiotemporal profile and to obtain pathophysiological information from ICG dynamics. Principal components of ICG dynamics in both feet showed significant differences between normal control and diabetic patients with vascular complications. We propose that PCA of ICG dynamics reveal better classification performance compared to fluorescence intensity analysis.

P2-17 GPGPU 병렬 연산을 적용한 고속 공초점 형광수명 이미징 연구

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오송첨단의료산업진흥재단

We propose GPGPU parallel processing for high-speed confocal fluorescence lifetime imaging. Since the fluorescence lifetime of each pixel can be ex-

tracted simultaneously, total processing time for fluorescence lifetime imaging is fast such that real-time confocal fluorescence lifetime imaging can be realized. In this study, we have proved the total processing time for fluorescence lifetime imaging by GPGPU was improved more than 25 times comparing to single CPU processing.

P2-18 근적외선 분광 시스템을 이용한 부항시술 중 혈역학 변화 관찰

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Cupping therapy has been practiced mostly in Asia and Europe since 1550 B.C., but there are very few studies to monitor the efficacy of therapy. Thus, the main goal of this work is to show the potential of near infrared spectroscopy to be a suitable technique to monitor the effect of cupping therapy by recording the hemodynamic response during the therapy. The results show a significant increase of oxy-hemoglobin with minor decrease of deoxy-hemoglobin under the negative pressure, while the release of negative pressure caused an oxy-hemoglobin decrease with an increase of deoxy-hemoglobin. The results show that near infrared spectroscopy may provide important information to enhance the effect of the cupping therapy for a personalized treatment.

P2-19 수술 중 Macrophage Targeted Fluorescent; Indocyanine Green: Neomannosyl Human Serum Albumin를 이용한 전이감시림프절 탐색

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The presence of metastasis in sentinel lymph node (SLN) was important to decide whether the invasive lymph node dissection should be carried out or not during the surgery for many solid cancers. We developed a CD 206 targeting fluorescent which is one of marker of tumor associated macrophage. This study is to evaluate if a new macrophage targeting near infrared fluorescent (indocyanine green: neo-mannosyl human serum albumin, ICG:MSA) could identify the presence of metastasis in SLN through a custom-made intraoperative color and fluorescence merged imaging system (ICFIS) during surgery.

Medical and Bio-informatics

P2-20 생체 전기 임피던스 측정을 통한 화상진단 방법

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The diagnosis of burn injury needs an accurate identification of depth of injury. The depth of burn is related to the ability of the skin to restore and regenerate itself. In current clinic, burn injury is evaluated by visual assessment and biopsy, the accuracy of which is dependent on physician's experience. For quantitative diagnosis, we proposed skin impedance analysis methods. Skin is composed of several layers having different impedance characteristics. We made burns models using porcine skin by physical, chemical and thermal means and analyzed their electrical impedance. It was found that skin burns and bio-electrical impedance are correlated each other.

P2-21 퍼플루오로헥산 중심의 리포솜을 이용한 초음파 피부 약물 전달

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In this study, perfluorohexane core liposome, which is denser than solution and can form bubbles by low intensity ultrasound, was proposed as an alternative cavitation seed for sonophoresis instead of ultrasound contrast agent. Two types of perfluorohexane core liposome with/without size control using 100 nm filter extruder, and one commercial UCA, Definity®, were mixed to ferulic acid (10,000 ppm). The amount of delivered ferulic acid by sonophoresis with the proposed liposomes was up to four orders greater compared to that of diffusion. Perfluorohexane core liposome which has high density can induce sonophoresis efficiency.

P2-22 이마 안전도 기반의 인간-컴퓨터 인터페이스를 위한 실시간 안구 운동 방향 구별 알고리즘 개발

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In this study, real time eye movement classification algorithm was developed for forehead EOG (electro-oculogram) based HCI (Human-Computer Interface). Maximum amplitude, minimum amplitude and those time index in window were extracted to classify the direction of eye movement. To evaluation the algorithm, electric wheelchair driving task was performed. Eye movement to up, down, left and right were matching up with go staight, stop, left turn, right turn of wheelchair.

Medical Imaging

P2-23 정량적 자기공명영상을 이용한 다계통위축증, 파킨슨병, 진행성 핵상마비증에서 철 침착변화의 관찰

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The aim of this study was to assess regional brain atrophy and iron content in PD, PSP, MSA-c and MSA-p. R2* values and volumes were calculated for the selected subcortical structures (globus pallidus, putamen, caudate nucleus, and thalamus). Total 33 patients were enrolled from Pusan National University Yangsan Hospital. Data processing was performed using FSL & SPM8. For group analysis, two-sample t-test was performed using General Linear Model. In MSA-p groups, significant increases in R2* were found in the putamen of MSA-p at follow-up. The R2* values in these areas tended to increase in parallel with the extent of atrophy.

P2-24 탄소나노튜브기반 양극 회전형 전계방출 엑스레이튜브 개발

류제황[1,4], 홍지환[3], 여승준[2], 안정선[2], 박규창[2], 박헌국[1]
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We report the design and fabrication of a carbon nanotube based an anode-rotating type field emission x-ray tube without vacuum pump. The x-ray tube consists of four electrodes with anode, focusing, gate cathode electrode. The shape of cathode by lithography process is ellipse for isotropic focal spot size at anode target. The obtained x-ray images show clearly micrometer scale.

P2-25 Simulation of eddy currents in MRI and its possibility to detect

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Eddy currents are inevitably induced when time-varying magnetic field gradients interact with the metallic structures of a magnetic resonance imaging (MRI) scanner. The secondary magnetic field produced by this induced current degrades the spatial and temporal performance of the primary field generated by the gradient coils. A rapid change in the gradient field induces eddy currents in the conducting structures of an MRI system, resulting in the production of image artifacts. In this article, a technique is described which allows the finite difference time domain (FDTD) method to be efficiently applied over a very large frequency range, including low frequencies. A method to simulate the current induced by coils of arbitrary geometry has been presented. The method combines the advantage of integral and differential schemes by correctly introducing far boundary conditions and physical properties to the model. An objective of the present study is to investigate detecting of this current on magnetic resonance imaging (MRI) scanner. On the other hand, with this data, all quantities that depend on the current density, such as the secondary magnetic field, are simply evaluated. Accurate simulation of these eddy currents is important in the successful design of gradient coils.

P2-26 콘빔CT에서 직접 및 간접변환 방식 영상의 히스토그램 분포 비교

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Bone microstructure parameter is the important factor to measure the bone strength, Cone beam computed tomography (CBCT) could be applied to assess this parameter. In this study, the direct conversion detector and indirect conversion detector with CBCT system were employed to acquire the histogram of pig rib image. This histogram is required for application of Otsu threshold method. The

results of the experimental study showed that the histogram of direct detector has more distinguishable bimodal shape, so the direct detector has an advantageous for finding the thresholding point.

P2-27 초음파 변환기의 음향 출력 자체 감시 기술

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Ultrasonic transducers gradually deteriorate with time or suddenly lose their piezoelectric functions during their clinical uses. Silent nature of ultrasonic production does not give clinical users noticeable signs for the problem, and, therefore, a practical way of self-testing the transducer performance is important to maintain the clinical efficacy. In the present study, an experimental test was carried out on an ultrasonic transducer whose capacitance was altered to simulate the deterioration of piezoelectric function. It was found that the capacitance changes resulted in reduction in the applied voltage to ultrasonic transducer. This suggests that the real time monitoring of the voltage enables us to test if the ultrasonic transducer performs as it is expected to be.

P2-28 증강현실을 이용한 태블릿PC 기반 악교정 수술 가이드 시스템

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An orthognathic surgery is aimed at correcting maxillofacial deformities related to the acquired and inherited dento-facial defects. Several former studies have been developed computer-aided orthognathic surgery using computed tomography (CT) and optical

tracking system to do preoperative surgical planning and intraoperative surgical navigation. In this study, we added a Windows 8.1 tablet PC based augmented reality (AR) technology to the developed image- guided orthognathic surgery system (IGOSS). The tablet PC guidance system could provide an intuitive comprehension of a situation of the surgery to a surgeon, and facilitate a flexible space application in operating room.

P2-29 멀티에너지CT에서 선형감쇠계수 비율을 이용한 물질구분 기술

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Photon counting detectors provide more than one spectral measurement. The purpose of this study is to investigate, with experiment, the ability to decompose materials using linear attenuation coefficient ratio. Linear attenuation coefficient ratio was considered as density-regardless features of multiple energy CT. A small field-of-view energy discriminating CT system was built. The results of the experimental study showed that a CT system based on photon counting detectors with linear attenuation coefficient ratio can be used to decompose materials.

P2-30 Resting-state functional MRI 연결성을 이용한 THC 사용자 그룹 분류

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Tetrahydrocannabinol(THC) is a major component of cannabis. Previous studies found functional differences on specific brain regions between THC used- and THC-unused-group. In this study, we assessed

group-wise differences using a network parameter obtained from connectivity analysis of resting-state functional magnetic resonance imaging (fMRI). We then used support vector machine (SVM) to classify two groups aforementioned by using network para-meters as imaging features. The accuracy was mea-sured as 80% (Sensitivity=90%, Specificity=70%).

P2-31 뇌의 기능적 연결성을 이용한 반 사회적 인격장애 분석

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Antisocial Personality Disorder is described as indi-vidual behavior lacking consideration for others. The goal of this study was to examine group-wise diffe-rences using network parameter between subjects with antisocial personality disorder and health sub-jects. We used resting state functional magnetic re-sonance imaging and constructed correlation matrices. Analysis of these matrixes with graphic theory extra-cted local network parameter to compare with. There was significant difference found in right lingual gyurs compared with healthy control. In summary, the current analysis suggests that the visual sensory processing functionality was different for subjects with antisocial personality disorder compared with healthy controls.

P3-32 확산 텐서 영상의 구조적 연결성을 고려한 간질환자의 선택적 편도해마 절제술의 계획

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Epilepsy surgery is one of the treatment options for epilepsy patients. Among various surgical methods,

temporal lobe resection accounts for half of the treatment options. Early temporal lobe surgery had critical side effects because it removed large amounts of neocortex. Selective amygdalohippocampectomy, one of the temporal lobe surgery methods, has less side effects because it removes small amount of the neocortex. We suggest a brain region to start the surgery by using structural connectivity derived from DTI tractography.

P3-33 Task functional MRI를 이용한 주의력 결핍 과다 행동 장애 환자의 정신질환 진단 및 통계 편람 점수 예측

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Attention Deficit Hyperactivity Disorder (ADHD) is a prevalent psychiatric disorder which shows symptoms of inattention, hyperactivity, or learning disability. ADHD is diagnosed to three subtypes; inattention (IA), hy-peractive/impulsive (HI), and combined (C) type according to the Diagnostic and Statistical Manual of Mental Disorders (DSM) scores. In this study, we predicted DSM scores related to ADHD by applying linear regression using network parameters (between-ness centrality and degree) acquired from connectivity analysis of task functional magnetic resonance imaging (fMRI). Regional network parameters reflecting group-wise differences between ADHD and normal were used as predictors in predicting DSM scores.

P3-34 간암 환자의 시계열 CT에 TACE 이후 종양의 치료 반응에 대한 Parametric Response Map기법의 적용

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Hepatocellular carcinoma (HCC) is one of the most

frequently occurring malignant tumors. TACE is non-surgical treatment option for HCCs. The accurate and early detection of tumor response is important for proper intervention planning. Parametric response mapping (PRM) is method for observing intensity change in longitudinal datasets. In this paper, we applied PRM approach to observe changes of tumor response after TACE treatment. We collected eight subjects with HCCs and they were classified as CR (complete response) and non-CR group. Our analysis showed differences of scatter plot and PRM value between CR and Non-CR.

P2-35 만성 알코올 섭취자의 작업 기억 과업 수행 중 뇌 네트워크 영향력 분석

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Chronic alcohol consumption is related to impairments in cognitive and memory functions. In this study, we acquired working memory task functional MRI images of ten normal controls and ten chronic alcohol consumers. Brain network analysis using graph theoretical approach was adopted. All subgroups showed small-world property. These groups showed significant differences in betweenness centrality at the left parahippocampal region. This result would serve as basis for using various task-based functional MRI for analysis of chronic alcohol consumption.

P3-36 영역기반 정준상관분석을 통한 알츠하이머병과 혈관성 치매의 대뇌 구조적 네트워크 특성 분석

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Alzheimer's disease (AD) and small vascular cognitive impairment (SVCI) had in common with relatively similar symptoms, such as gray matter atrophy and white matter abnormal changes, although they had not a same pathology. We proposed a regional sparse canonical correlation analysis (SCCA) to investigate structural associations as well as interactions in both gray matter and white matter integrity derived from diffusion tensor and T1-weighted structural MR images. We constructed graph theory-based cortical structural network and measured the network properties to interpret pathological difference between AD and SVCI.

P3-37 고주파 초음파 집게의 체내 응용을 위한 혼탁한 매질에서의 세포 포획 기술

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We experimentally demonstrate acoustic trapping of a cell in turbid media and the associated fluorescence imaging technique for in-vivo applications. Using a high-frequency single-element ultrasound transducer, a live cell was successfully trapped and displaced at target positions in turbid media. Blurring effect on fluorescence images of a cell trapped in turbid media was examined and then deblurring algorithms were employed to obtain a cell image with high contrast. These results suggest that acoustic trapping of a cell in turbid media can be realized and the associated fluorescence imaging technique may be useful for monitoring of a trapped cell in vivo.

P3-38 슬림형 다목적 초고해상도 감마선 영상 장치 개발

정영준, 차혜미, 민은기, 이학재, 이기성
고려대학교 바이오의공학부

In the development of MRI fusion nuclear medicine imaging system, gamma-ray detectors located in the MRI bore. The gamma-ray detector had a thick structure and acquired an image with limited spatial resolution. Moreover, the detectors should be changed in order to acquire the image of different radioisotopes (RI) or image acquisition method. We developed multipurpose low-profile high resolution gamma-ray detector with a slim structure. In this study, we evaluated the developed gamma-ray detector by acquiring the flood image of different RIs. The submillimeter level pixels were clearly distinguished at the flood image of different RIs by the developed low-profile gamma-ray detector.

P3-39 녹내장 치료를 위한 초음파 전극의 위치 설정에 따른 대상 조직에 대한 초음파 노출량의 변화

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Low intensity ultrasound has been proved to be effective to reduce the ocular pressure which is highly associated with glaucoma. The study considers the ultrasonic exposure to the target tissue which is expected to be changed when locating the ultrasonic electrode. Acoustic fields in the anatomical structure of eye were numerically evaluated using a finite element method when tilting the ultrasonic electrode in the same position. As expected, the ultrasonic pressure at the trabecular meshwork known to play an important role in maintaining intraocular pressure, decreases with the tilt angle, more sensitive in an annular type electrode than a disk type. However, it was found the disk type produce large local pressures which are rarely observed in the annular type. This suggests that the ultrasonic electrode has an annular shape and needs to optimize the inner diameter for making the ultrasonic irradiation safe and effective.

P3-40 자동 분할된 상기도 MR 영상에서 폐쇄성 수면 무호흡증 환자의 체중과 광류 방법 사이 상관관계 분석에 관한 연구

황윤호, 이민희, 민아름, 이상현, 김동윤
연세대학교 의공학과

Obstructive sleep apnea syndrom is respiratory disorder disease occuring sleep problem during sleep because of restricting part or all of upper airway. If the degree of OSAS is serious, it appears growth and character disorder, and affects physiological function and learning ability. In our study, we quantitatively measured the change of upper airway after automatic segmentation of upper airway in MR image of child with OSAS. We analyzed the correlation between its weight and mean of optical flow values measuring quantitatively. We found the fact that the more increased weight, the bigger changes of upper airway.

P2-41 유방촬영술에서의 흉근 검출 방법

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Mammography images have been actively used in diagnosis (CAD Computer-Aided Diagnosis) research systems. Mammographic image segmentation in the CAD system has three major different regions; the breast boundary, nipples, pectoral muscle. In this study, we propose the pectoral muscle detection method from mammography images. We used 66 images from 33 patients. For the Evaluation, We compared two different detection methods; automatically and manually drawn for pectoral muscle area. As a result, we obtained FN = 2.35%, FP = 5.8%. FN average area decreased as compared to other methods. We are expected to be able to contribute to the detection of breast lesions using a CAD system.

P2-42 CT와 MRI 영상의 복강 내 림프절 영상 분할 및 3차원 정합의 유용성 연구

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The position of patient's organs, such as lymph nodes and cancer tissues, is required in order to provide appropriate surgical methods and treatment plans in colorectal cancer cases. In this study, authors compare the accuracy constituted by 3-D volume data from medical imaging devices of CT and MRI. After confirming cancer lesions and the position of the lymph nodes, we make registration images of the two devices. As the results, registration images detect nine more lymph nodes and 60 percents higher volume than CT images.

P2-43 인지 과제 수행시 발생하는 대뇌 쌍극자 변화 분석 : MEG 연구

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Magnetoencephalography is a functional neuroimaging technique for mapping brain activity by recording magnetic fields produced by electrical When the name and color are matched, we called 'congruent', is not 'incongruent'.currents occurring naturally in the brain. MEG is a very effective way of spatial and temporal analysis of the number of nerve activity in the brain. While performing the cognitive task that we want to find area of the brain is activated and the reaction by the analysis of neural activity.

P2-44 CT에서 폐암의 체적측정을 위한 3차원 반자동 분할 방법

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In this paper, we propose an automatic lung cancer segmentation method with minimal user intervention. First, entered the region of interest to the user, and improve an image by filter. Then, we extend the rolling-ball algorithm to three-dimensions. And detected lung cancer by deformed so as to determine fit the size of the sphere mask on the situation. A comparison with the result of manual segmentation by an expert showed 0.84 of DSC, 78.36% of sensitivity, 99.97% of specificity, and 0.991 (p=0.01) of correlation.

P2-45 국내 10세 소아 영상의학검사의 Diagnostic Reference Level 마련 연구

이승열, 이준호, 박상건, 김산, 이정주
이승노, 이창형, 김혁주, 서경원
식품의약품안전처 식품의약품안전평가원
의료제품연구부 의료기기연구과

According to UNSCEAR 2008, the annual frequency of diagnostic medical examinations and annual per caput effective dose has increased internationally. In Republic of Korea, the number of diagnostic medical examinations was 222 million and the annual per caput effective dose was 1.4 mSv in 2011. It showed a marked increase of 37% and 50% over the 5 years, compared with 161 million and 0.93 mSv in 2007, respectively. In particular, in the case of children (10 years), who are more sensitive to radiation than adults, Diagnostic Reference Level (DRL) has been required to prevent excessive exposure.

P2-46 전임상용 가변형 핀홀 SPECT 시스템 개발에 대한 시뮬레이션 연구

천재희, 배재건, 배승빈, 이학재, 이기성
고려대학교 바이오의공학부

This article describes variable pinhole collimator SPECT(VPSPECT) which can change its own shape on purpose. Through comparison with conventional pinhole SPECT system, it was demonstrated that VPSPECT system has the advantages of image acquisition for region of interest. MOBY phantom was used to simulate the pre-clinical experiments, and the heart of phantom was set for region of interest in the simulation of VPSPECT system. The result shows that VPSPECT system improve the sensitivity up to 199%, and image of that has less noise and was closer to the original image compared to the conventional pinhole SPECT.

P2-47 선형 판별 분석(Linear discriminant analysis)을 이용한 상처 분할

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Quantitative analysis of skin wound is critical in objective evaluation of a therapy. In this paper, a robust wound segmentation method is presented, which does not need a threshold. The proposed method uses a color feature obtained from linear discriminant analysis (LDA), therefore, the segmentation is quite stable to variation of color characteristics of a camera used for image capture or illumination. Experimental results demonstrate the efficacy of our proposed approach.

P2-48 치아수복재의 피로진단을 위한 방사광 x-ray 현미경의 유용성

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Among studies to analyze fatigability effect by tensions on tooth restoration materials, there has been no research of fine structure due to absence of equipment for analysis. This research observed fatigability by exerting fatigue on each regine, to prove fatigability of tooth restoration materials. Evaluation by a radiation beam enabled observation of a fine crack and three-dimensional inspection compared to other two methods by eyes or a microscope. This result can be presented as a method in studies of tooth restoration materials in dentistry and dental technology.

P2-49 자기조직화 지도를 이용한 휴지 상태 뇌의 디폴트 네트워크 예측

황정민[1], 차정호[1], 이진성[1], 서상원[2], 나덕렬[2], 이종민[1]
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There are several networks in brain connectivity in the brain. One of well-known networks is default mode network (DMN) that increases in the absence of a driving task. This may not be proper to detect DMN individually since seed location and size in each subject are different in seed-based analysis. Alternative is to use a self-organizing maps (SOM) and batch-SOM derived from the SOM which is appropriate to large scales data. The analysis revealed that DMN was observed well by batch-SOM but not the SOM. These findings indicate that the batch-SOM is a complementary method to extract DMN.

P2-50 사이클로헥실아민과 콘쥬게이션한 DO3A 가돌리늄 착물 합성과 MR 조영제로서의 작용

We report the design and synthesis of DO3A conjugates of tranexamates with terminal amine and its Gd-complex(5) as a MR contrast agents. The. r1-relaxivitiest also compare well with those of commercial agents, indicating similar values. It behaves

much like ordinary ECF CAs such as Gadovist® and was employed in vivo.

P2-51 초분극화 탄소-13을 이용한 동적 물질 대사 자기공명영상 기법

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Hyperpolarized 13C magnetic resonance imaging (MRI) has been widely used to acquire metabolism kinetics between injected substrates and their downstream metabolites. The challenge here is encoding multiple dimensions while still providing sufficient resolution in each dimension to distinguish the captured information in vivo. At ultra-high field environments (beyond 3T) however, spectral dispersion between resonances becomes significantly wider, thus providing a basis for leveraging the tradeoff between spatially and spectrally resolving different metabolites. Here, a simple acquisition method for hyperpolarized 13C MRI which utilizes severe spatial displacement between resonances to dynamically resolve metabolic imaging of [1-13C] pyruvate and lactate is presented.

P2-52 Sparse 표현과 뇌량 밝기 확률분포도를 이용한 자동 뇌량 분할

박길순, 곽기창, 박영훈, 서상원, 나덕렬, 이종민
한양대학교 생체의공학과
서울삼성의료원 신경과

The corpus callosum (CC) is the largest white-matter structure in human brain. Size and shape of CC help to performance many neuroimaging studies. Accuracy and stabile segmentation method was required for to acquire proper results of the study. In this paper, we developed CC segmentation method which is composed of Bayesian and sparse representation.

P2-53 적응적 이진화 기법을 이용한 세포 검출 알고리즘 연구

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Movement with the development of nano-bio industries cells was discovered in the course of cell growth, division, integrated, deformation of the shape, the development of an automated system for analyzing the behavior of cells, such as interaction between Sebo is it is very important. In this paper, We propose a detection algorithm of cells for automated detection of cell. Detection algorithm cells utilizing adaptive binarization approach from the input image, by dividing the boundary of the background and the cell, to detect the cell contour. And will detect the last cell to the detected contour through edge strength comparison. As a result, the proposed algorithm toughness and the output signal-to-noise ratio of the noise as compared to other conventional methods, showed better detection rate in terms of edge matching rate and the detection accuracy.

P2-54 피크 검출을 이용한 HCS 시스템의 세포 관심영역 추출 기술

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Cell detection in microscopy images is an important step in the automation of cell based-experiments. We propose a peak detection based cell detection method. The method consists of two steps: first, a set of candidate cell-like regions is identified. Then, each set is grouped like circle by hough transform algorithm. The method is robust for brightness differ from other method. We designed the method for High Content Screening System. The algorithm had been tested to evaluate the performance under the condition of non-uniformed light. The algorithm had shown excellent

performance in cell detection, compared to other conventional methods.

P2-55 T1강조 영상을 이용한 인터넷 중독이 뇌의 백질과 회백질의 부피에 미치는 영향에 관한 연구

이상현[1], 이민희[1], 민아름[1], 황윤호[1]
김동윤[1], 한봉수[2], 서형석[3]

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Recent research reported internet addiction changes the brain structure. So, we analysis volume changes in the brain structures of patients with internet addiction. In this study, whole brain 3D T1-weighted images were used and segmented them into gray matter and white matter. In order to investigate whether there were any changes in the brain structure, we parcellated each gray matter and white matter into 116 sub-regions using automated anatomical labeling template and compared their volume with that of control group. In temporal lobe and amygdala region, we found significant volume changes. Our finding suggest that internet addiction is related with volume changes on some region of brain.

P2-56 생체 내 양성자 자기공명분광법을 이용한 지방간의 횡축 (T2) 이완시간변화의 평가

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[2]가톨릭대학교 생체의공학연구소

The aim of this study was to evaluate transverse relaxation time of methylene resonance compared to other lipid resonances. The examinations were performed using a 3.0 T with a PRESS sequence. Both groups drank water ad libitum. T2 measurements in

the rats' livers were conducted at a fixed-TR, multi-TEs. The T2 relaxation time of methylene resonance was estimated as follows: NC rats, 37.07 ± 4.32 msec; HF rats, 31.43 ± 1.81 msec (p < 0.05). This study led to sufficient spectral resolution and signal-to-noise ratio differences to characterize all observable resonances for yielding T2 relaxation times of methylene resonance.

P2-57 의료영상의 저작권 보호를 위한 디지털 워터마킹

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이도병[1], 유재용[1], 이종민[1,3]

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[3]경북대학교 의학전문 대학원 영상의학교실

In this study, the wavelet transform domain is proposed by the method of insertions using the information of image shape in the structure and the spatial region.[1] A location of the watermark insertion is the candidate regions which are determined in sub-band having a high frequency. After the insertion, performing of the inverse wavelet transform (IDWT) creates the image which is a inserted watermark image. Using the proposed method, the PSNR (Peak Signal-to-Noise Ratio) could confirm the results of excellent invisibility by observing a inserted watermark image. Therefore, this study is considered to be applicable for copyright protection or ownership certification etc. in medical images requiring the best qualitified image.

P2-58 인도시아닌 그린 약물동역학의 정량적 비대칭 정도 분석을 이용한 레이노 현상의 진단

안유리, 이정설, 최철희
KAIST 바이오및뇌공학과

Raynaud's phenomenon (RP) is a functional vascular insufficiency that plays an important role in clinics. Previously, we have developed a novel near-infrared imaging system for visualization of tissue perfusion non-invasively using indocyanine green (ICG) as a vascular tracer parameter. We also have shown that asymmetric pattern analysis is a good diagnostic tool for vascular disease such as RP. In this study, we suggest new asymmetric pattern quantifying method that can be used as a rational diagnosis method of RP.

P2-59 부분용적효과를 고려한 확산텐서영상에 대한 관심영역 분석 연구

최우혁[1], 강경훈[2], 윤의철[1]
[1]대구가톨릭대학교 의공학과
[2]경북대학교병원 신경과

The purpose of this paper is to improve accuracy of ROI study for diffusion tensor image. Partial volume effect (PVE) is used to reduce an amount of gray matter and cerebral spinal fluid within ROI. The result showed that the average of fractional anisotropy (FA) within ROI was increased, but standard deviation was decreased when PVE was interconnected with template based ROI study. It meant that PVE would contribute to make an accuracy of ROI study better.

P2-60 그래프 컷 방법을 이용한 뇌 자기공명영상 피질 하부 영역 분할

홍진우[1], 박성범[1], 곽기창[2], 이종민[2], 윤의철[1]
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Segmenting of subcortical area form brain MRI was very difficult since it was relatively small and had various shapes. In this paper, template-based segmentation and partial volume effect were incorporated for initial value of graph-cuts algorithm. The proposed method was validated with well-known tool (FSL-FIRST) using dice similarity index, recall and precision values. As a result, the proposed method (SI (left, right): 0.875 ± 0.016, 0.870 ± 0.016; Recall: 0.867 ± 0.020, 0.881 ± 0.021; Precision: 0.884 ± 0.025, 0.860 ± 0.035) was significantly better than the other (SI: 0.868 ± 0.018, 0.870 ± 0.012; Recall: 0.864 ± 0.029, 0.880 ± 0.022; Precision: 0.872 ± 0.019, 0.862 ± 0.027).

P2-61 그래프 컷 방법 기반의 측 뇌실 자동 분할에 관한 연구

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Quantitative measure of the lateral ventricle from MRI would enable earlier and more accurate clinical diagnosis. However, it requires a delicate segmentation method for objective quantification. It is not easy to define lateral ventricles because of contrast, brightness and signal-to-noise ratio of MRI. In this study, we proposed a hybrid segmentation method for lateral ventricle based on graph cuts algorithm combined with atlas-based segmentation and connected component labeling. The proposed method was validated with well-known tools (FSL-FIRST, SPM-ALVIN) using the dice similarity index, recall and precision values. As a result, the proposed method was significantly better than the others.

P2-62 확산 텐서 영상을 이용한 수면 무호흡증 환자의 성별 차이 분석에 관한 연구

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Patients with obstructive sleep apnea are accompanied with affective and cognitive disorders and show abnormalities in multiple brain regions. Patients with obstructive sleep apnea show different aspects in male and female. Fractional anisotropy based on diffusion tensor imaging measures integrity of brain tissues. Recent studies have revealed alterations of brain tissue using fractional anisotropy. In this study, we examined sex differences in obstructive sleep apnea using diffusion tensor imaging. We identified more alteration of regions related to memory and emotion in female patients than male patients.

P2-63 척추 DXA 이미지 분석을 통한 골절 구분력 평가

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Dual-energy X-ray Absorptiometry image of lumbar was analyzed using Minkowski functionals used in descript of biomechanical strength in bone to differentiate osteoporosis-related fracture from those who do not have a fracture. Among 933 subjects, 152 subjects have fracture of the lumbar whereas the other 781 subjects have not. To assess the discrimination between fracture and non-fracture, Receiver-Operating-Characteristic analysis was employed. The Area-Under-the-Curve calculated by Minkowski functionals was 0.6968 and the sensitivity was 0.717.

P2-64 풍선 카테터의 시뮬레이션을 위한 기하학적 모델

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This paper proposes a geometric model for balloon catheter simulation, which enables the deformation of the balloon catheter without using a physics model. A shape function is designed to reflect the deformation characteristics of the balloon catheter. The proposed model is compared to the behavior of the actual balloon catheter by measuring the length of the lines on the cross section. The maximum relative error is 3.45%.

P2-65 양성자 자기공명분광을 이용한 지방간 쥐에서 간 지질 변화

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Non-alcoholic fatty liver disease is the most common cause of chronic liver diseases. Liver lipid content has been suggested to play an important pathogenic role in the development of liver fibrosis and cirrhosis. The aim of this study was to characterize early hepatic lipid changes in fatty liver rat model by in vivo short-echo time (TE) 1H-MRS. In this study, Lip 21, Cho, Total unsaturated fatty acid (TUFA) were higher in the fatty liver rats, but not significant between 0 week and 2 weeks (p>0.05). The increase in liver may reflect the lipid-induced cell toxicity, which has been suggested to be related with activated apoptosis induced by saturated fatty acids. Therefore, 1H-MRS is useful in detecting and characterizing various hepatic lipid alterations as early as 2 weeks for the start high fat diet.

P2-66 분극 역전층 기법을 적용한 혈관 내 초음파 변환자의 성능 검증

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동국대학교 의생명공학과

In this paper, we applied inversion layer technique to intravascular ultrasound (IVUS) transducer to achieve features of high frequency and wide bandwidth. PMN-PT and PZT-5H were used as active materials and the total thickness of active material was designed at 40 MHz. The results show that the front-side inversion case had center frequency of 62 MHz and -6 dB fractional bandwidth of 90 %. The back-side inversion case had two peaks at the fundamental and second harmonic frequency, and center frequencies were calculated at 40 MHz and 85 MHz, respectively. The -6dB fractional bandwidths were 39 % and 26%. As a result, we demonstrated that inversion layer technique can effectively improve the performance of IVUS transducer.

P2-67 초음파 영상에서의 좌심실의 움직임 추적을 위한 국소화된 전역 변형 모델

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국가수리과학연구소, 계산수학연구부

Due to ultrasound artifacts, dropout or shadowing phenomena of cardiac walls, echocardiography data is often corrupted heavily in some local regions. In this paper, we propose a robust real-time left ventricle (LV) border tracking algorithm for the corrupted echocardiography. The proposed method deals with motion of the corrupted LV shape by applying global deformation modeled as affine transform partially to the contour. We partition tracking points on the contour into a few groups and determine each affine transform governing the motion of the partitioned contour points. To compute the coefficients of each affine transform, we use the least squares method with equality constraints.

P2-68 신호원 및 센서 수준의 뇌파 신호를 이용한 머신 러닝 기반의 조현병 진단 기술 개발

심미선, 김도원, 이승환, 임창환
한양대학교 생체공학과

In this study, we used both sensor-level and source-level features extracted from EEG signals recorded during auditory oddball task for the classification of schizophrenia and healthy control. EEG signals from 34 patients with schizophrenia and 34 healthy controls were recorded while each subject was asked to attend to oddball tones. The results showed higher classification accuracy when source-level features were used with sensor-level features simultaneously, compared to when only sensor-level features were used. In addition, the selected sensor-level features were mostly found in frontal area, and the selected source-level features were extracted from temporal area, which reflects the well-known deficits of cognitive processes in patients of schizophrenia.

P2-69 MRI영상촬영 시 전자파인체흡수율과 온도 상승에 관한 측정 표준

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Heating of patients or burning of biological tissues by radiofrequency (RF) power during MRI scan is a significant safety concern. Time-varying RF magnetic fields can cause undesired local tissue heating or skin burn due to the RF power deposition in the conductive human body. The magnetic field strength is getting higher and higher in order to acquire better resolution of MR images. However, specific absorption rate (SAR) is proportional to the field strength. The SAR values reported by MRI systems are inaccurate. We did measure not only SAR but also temperature increase induced by RF heating using fiber optic sensors, independent from the values provided by MRI scanners.

P2-70 비접촉 광음향 영상과 광간섭 단층 촬영 장치의 결합 시스템

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광주과학기술원 [1]의료시스템공학과, [2]정보통신공학부

We demonstrate a combined system of noncontact photoacoustic tomography (NCPAT) and optical coherence tomography (OCT) to provide optical absorption and scattering information of biological sample. Both systems, NCPAT and PCT are composed of fiber-optic network, which share only one fiber probe to implement the combined system. The capability of the proposed system was evaluated by using a phantom containing black polyethylene terephthalate (PET) fibers and optical fibers. The combined system could be applied for medical diagnosis where noninvasive and noncontact imaging is required.

System Biology, Physiological Modeling

P2-71 콜라겐이 내포된 피부 조직 유사 팬텀 제작 연구

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In order to evaluate quality of the video, performance, treatment effect and technology of ultrasound equipment requires tissue mimic phantom. In this study, it is possible to easily produce, and we has produced particular tissue mimic phantom. Fabricated phantom that skin tissue mimic phantom is manufactured, including collagen, the main component of the skin. And the characteristics of actual skin tissue than soft tissue phantoms that are currently being used more widely expressed similarly. When Phantom production, the judge would be able to produce more than a considered tissue mimic phantom over the ratio of the materials used and additional.

P2-72 초음파 지방제거술용 변환기의 생체 조직에 대한 열 분포 시뮬레이션

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In fat removal method using high-intensity focused ultrasound, there are advantages to necrosis of adipose tissue in a short time. But, there can be generated damage of normal tissue in the surrounding. We simulated the thermal distribution by the intensity in the adipose tissue. The area of focal region has been identified 0.9667 $[mm^2]$ at -3dB. And thermal distribution was confirmed that gradually widening to the maximum area 113.18 $[mm^2]$ (500 kPa) from minimum area 4.8 $[mm^2]$ (100 kPa) depending on the intensity. The results of this study may be used as basic parameters of the research in ultrasonic treatment

P2-73 인간지방줄기세포 상태 분석을 위한 전단 유동 마이크로 시스템

안기훈, 이기훈, 김성환, 이승진, 박중열

중앙대학교 기계공학부

Lab-on-a-chip or micro total analysis systems (μ-TAS) have been studied especially to biotechnological processes. Stem cells (SCs) have been one of the biggest issues in biological research because they have infinite potentials for medical treatments. Shear stress, as one of the mechanical forces, has a particular role for stem cell differentiation. In this study, we confirmed influence of shear flow onto human adipose-derived stem cells (hASCs). The hASCs were developed their structure by induced gradient

of shear flow. These result enable to help other hASCs studies.

P2-74 한국인 제 2 당뇨 환자의 인크레틴 효과를 고려한 개인 맞춤형 혈당조절 모델 개발

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[3]서울대학교 의과대학 내과학교실
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The incretin effect, which is a distinctive stimulus of insulin secretion in response to oral ingestion of nutrients, is calculated by the difference in insulin secretory responses from an oral glucose tolerance test (OGTT) and a corresponding isoglycemic intravenous glucose infusion (IIGI) study. In this study, we developed a mathematical model considering the incretin effect and pathophysiological characteristics in Korean subjects with type 2 diabetes (Korean-T2D). For this, glucose data were collected from 9 Korean-T2D, and 3 model parameters were estimated by fitting these clinical glucose profiles during an OGTT. Consequently, the model was individualized to predict the glucose profile during both OGTTs and IIGI studies for each subject, and the simulated glucose profiles were similar with the observed ones from our clinical trial. This individualized model could be further utilized to develop the tailored closed-loop control algorithm based on characteristics of Korean T2D.

P2-75 Left Ventricular Assist Device Quantification on Electromechanical Delay: a simulation study

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Heart Failure (HF) is a major cause of death around the world. Several simulation and experiment study shows that Electromechanical Delay (EMD) is prolonged in HF. EMD depends on the mechanical load as well as electrical activation sequence. There is no study which quantify the effect of LVAD on EMD. Our hypothesis is that LVAD can shortens EMD by reducing mechanical afterload of the ventricle in severe HF. The result is consistence with our hypothesis that prolonged EMD caused by severe HF especially which has low concentration of calcium could possibly be treated using LVAD.

P2-76 복부대동맥류 내에서의 혈류유동에 관한 수치해석

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The aim of this study is to investigate the abdominal aortic hemodynamics in abdominal aortic aneurysm (AAA) patient. The blood flow patterns, internal pressure distributions and mean WSS for the patient-specific abdominal aortic models will be presented. It was found during diastolic phases the blood flows are getting more complex swirl in AAA, while the blood patterns are smooth during the systolic phases. A high WSS region was occurred in anterior region for high blood flow, but low WSS was occurred in both anterior and dorsal regions for low blood flow.

P2-77 MATLAB을 이용한 인공와우 전극 시뮬레이션

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This study was aimed to simulate the acoustic characteristics of cochlear implant. Cochlear implant uses direct electric stimulation on hair cells located on the cochlear tonotopically. Acoustic signals could be transformed into the signals in frequency domain. Though electrodes for electric stimulation transfer the total energy related to the specific spectral band, the same signals are applied in each electrode. In this study, these functions were simulated as a MATLAB based tool. Simulation tool was designed to control number and size of electrodes, amplitude and frequency of electric stimulation. The output of the cochlear implant simulator was transformed into sound signals. As increasing the number of electrodes, voice signals were close to the original sound.

P2-78 수화 인식을 위한 관성 센서 기반 데이터 글로브

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The deaf has problems in communication with normal people. According to development of information technology, It is researched that a lot of studies on sign language recognition for hearing-impaired people. This study presents a system of recognition of sign language with a data glove composed of the 3-axis inertial sensor and mag-netometer. On host program the data is acquired and is calculated to relative angle between palm and each fingers. The calculated data is displayed on the host program with 3-dimensional display. It is expected to apply to smart phone applications, for example emergency situation.

P2-79 한국인의 경구최소모델 적용에 관한 기초 연구

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Quantitative mathematical approaches on diabetes are important since insulin and glucose are measureable numerically and controllable by interventions. The oral minimal model is one of mathematical models which can predict the glycemic control in vivo. This model has the minimal number of parameters compared with other models, thus characteristics on glucose handling of subjects can be easily derived without over-fitting problems. In this study, the oral minimal model method was applied to Korean subjects with normal glucose tolerance, impaired glucose tolerance and type 2 diabetes. This model was able to predict glucose changes and insulin secretion responses in accordance with clinical data.

POSTER III

Biomedical Robotics

Medical Nano and Microtechnology

Neural Engineering

Tissue Engineering and Biomaterials

POSTER III

Biomedical Robotics

P3-01 우주환경모사를 위한 마이크로중력 모방 장치 개발 및 평가

황동현[1,2], 박지형[1,2], 김동현[1,2],
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Microgravity is an environmental risk factor which can lead to musculoskeletal disorder, such as bone loss and muscle atrophy, during and after long-term space flight. To overcome these problems associated with microgravity, it is necessary to develop the simulating system which can mimic the microgravity condition on the earth. In this study, we developed 3D clinostat system which can be used in bioscience research to study the effects of microgravity at the cellular level on the earth. In sequence, cellular test was performed to evaluate our developed system.

P3-02 탄성체–삼투압 약물주입펌프의 압력 분석

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강원대학교 융합시스템공학과

This paper proposes a drug infusion pump that infuse drug in certain speed. Drug infusion pump is medical device that infuse drug to patient who need long-term medication. Elastomers Drug infusion pump can be fatal to patient who infuse drug in certain speed because the flow rate decreased with decreasing the elastic force. Therefore in paper is proposed a combined form of elastomers-osmotic to solve to decrease of the flow. The proposed drug infusion pump was checked for validity by measuring the elastic force and osmotic pressure. The drug

infusion pump on basis of experimental results will be used for variety of patients

P3-03 내시경용 연속 봉합장치

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The minimal invasive surgical methods become a common surgical procedure prompted the development of endoscopic surgical instrument in clinical. The suturing method is one of basic technics for surgical operation. However, it is lack of development of surgical instrument in endoscopic suturing. Therefore, in this study has focused on developed both body and head of endoscopic successive suture device featuring safety and convenience. We worked the development of successive suture device as prototype to performed experiment in vivo (beef intestine) to determine validity of the instrument's design and possibility of feasible.

P3-04 광간섭 단층영상 센서 기반의 바이매뉴얼 스마트 미세수술

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대구경북과학기술원 로봇공학전공

In microsurgery, manual surgical tasks can be fundamentally classified into grasping, injecting, and cutting biological tissues. Simultaneous grasping and cutting maneuvers are necessary for accurate dissection of tissues. For effective bimanual microsurgery, we develop a dual SMART micro-surgical system to suppress hand tremors of both hands. It demonstrates the enhanced performance of bimanual microsurgery, compared to freehand.

P3-05 기어 및 링크 기반의 복강경 엔드이펙터 제작 연구

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The prototype of laparoscopic surgical robot's end-effector, which has an external diameter of 6 mm, was developed without mechanical string. The gripping motion of the prototype could be actuated by one micromotor. The prototype is installed at the robot arm with 6 degrees of freedom, which can be controlled by Hands-On-Throttle-And-Stick (HOTAS) device developed in Aerospace Engineering for aircraft pilot to operate many functions, for rolling motion of the prototype. Further studies are to be conducted for integrating the developed system with da Vinci research kit (dVRK) & novel master interface to perform additional function for dVRK.

P3-06 거울상 치료를 위한 6축 상지 재활 외골격 로봇거울로봇의 개선

고석규[1], 남형석[2,4], 범재원[3,4], 김원식[1]
박우정[1], 홍인지[1], 김성완[4,5]

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There are clinical proofs that a mirror therapy has positive results for hemiplegic stroke patients. In this research, a prototype of 6-axis exoskeleton robot for mirror therapy has been reviewed and improved some of the drawbacks. Final design of a symmetrical structured exoskeleton robot considers extensive ranges of patients' arm length and diameter, spasticity, and overall safety of the users. The improved 6-axis rehabilitation exoskeleton robot will cover patients even widely with reduced mass and size. Thus, it will aid clinical effects of the mirror therapy.

P3-07 비침습 자동혈압계 성능평가를 위한 시뮬레이터 개발

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Blood pressure is one of important vital signs for monitoring patients' medical conditions. Automated non-invasive blood pressure (NIBP) measurement devices calculate systolic and diastolic blood pressures from the oscillation in cuff pressure caused by periodic motion of artery. In order to verify the performance of NIBP devices, we developed a simulator capable to regenerate the oscillometric waveform obtained human subjects. The simulator provided pressure pulses to device-under-test and device readings were compared to the auscultatory references. By the performance verification of NIBP devices, the reliability of blood pressure measurement would be enhanced.

Medical Nano and Microtechnology

P3-08 트롬빈 검출을 위한 압타머 기반의 전기화학적 임피던스 분광법

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An aptamer-based biosensor was developed using electrochemical impedance spectroscopy (EIS). Aptamers are artificial nucleic acid ligands with a binding affinity to specific amino acids. Compared to

conventional antibodies for biosensors, the aptamer has several advantages in terms of stability, reproducibility, and the production cost. We aim to develop the novel biosensor platforms using aptamers to diagnose a variety of diseases. In the present study, we measured EIS using a potentiostat to detect 20, 100 and 500 nM thrombin. As a result, it was shown that electrochemical impedance spectroscopy is feasible for aptamer-based detection of thrombin.

P3-09 유연하고 침습이 가능한 미세신경전극을 이용한 말초신경신호 측정

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In previous study, we developed the flexible penetrating microelectrode array (FPMA) using micromachining technologies. Also, various types of flexible cables based on polymeric substrates were designed and fabricated for electrical interconnection of FPMAs to external instruments such as recording or stimulation system. In this research, the acute intrafascicular recoding in dog's sciatic nerve using a set of the developed FPMA including a flexible cable is described to verify the functionality of the neural electrodes.

P3-10 혈액 내 암세포 검출을 위한 원심분리 기술기반 자동화 시스템

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High purity for circulating tumor cell (CTC) isolation with full automation has been regarded as a key goal to make CTC analysis a "bench to bedside" technology. Here, we describe a novel centrifugal microfluidic platform that can isolate the rare cells from a large volume of whole blood. To isolate CTCs from whole blood, we introduce a disc-based device having the biggest sample capacity as well as manipulating blood cells for the first time. The fully automated disc platform could handle 5 mL of blood by designing the blood chamber having a triangular obstacle structure (TOS) with lateral direction. To guarantee high purity that enables molecular analysis with the rare cells, CTCs were bound to the microbeads covered with anti-EpCAM to discriminate density between CTCs and blood cells and the CTCs being heavier than blood cells were only settled under a density gradient medium (DGM) layer. The novel TOS disc-based CTC isolation platform possesses not only large-volume capability but also a fully automated system, with high recovery rate and purity.

P3-11 이산화규소 유리 기판 상에서의 살아있는 구형 세포의 변칙적 랜덤 워크 특성 연구

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김영호[1], 이세영[1], 윤영로[1], 윤대성[2], 이상우[1]
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The random walk of spherical living cells on a silicon dioxide glassy substrate was studied experimentally and numerically. This random walk trajectory exhibited erratic dancing, which seemingly obeyed anomalous diffusion (i.e., Lévy-like walk) rather than normal diffusion. Moreover, the angular distribution ($-\pi$ to π) of the cells' trajectory followed a "U-shaped pattern" in comparison to the uniform distribution seen in the movements of negatively charged polystyrene microspheres. These effects could be attributable to the homeostasis-driven structural resilient character of cells and physical interactions derived from temporarily retained nonspecific binding due to weak forces between the cells and substrates.

P3-12 유전자 전달을 위한 Echogenic liposome 제작 및 평가

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Ultrasound Contrast Agents (UCAs) have been studied for drug delivery applications since cavitation of bubbles can increase the temporary permeability of nearby cells. However, the internal volume of UCAs is generally filled with a type of gas, hence encapsulation of drug molecules into UCAs is limited. In this study, one type of echogenic liposome having a liquid and gas core is proposed as an alternative carrier of genetic material for ultrasound-mediated drug delivery, which is known as sonoporation. We developed an echogenic liposome using liquid phase perfluorobutane and the structure of echogenic liposome was analyzed with TEM. The possibility of encapsulating FAM-NC siRNA into the proposed echogenic liposome was validated using confocal microscopy. The approximately 88% of total FAM-NC siRNA signal sites was overlapped with bubble locations. The protection of siRNA by echogenic liposomes was also verified by exposure to RNase. The results indicate that at least 20% of the total siRNA used in experiment was successfully protected by the proposed echogenic liposome.

P3-13 전기유전영동 집게(dielectrophoretic tweezers)를 활용한 poly-cytosine DNA의 상호작용력

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DNA has become the material of choice for nanometer-sized object (i.e. drug-release vehicles) due to predicted secondary structure and easily synthesis. To date, it is shown that non-canonical base pairs can be formed in acidic medium and presence of cations. It is also reported that poly-cytosine DNA form parallel-stranded duplexes where a base pair is formed between two cytosine bases when one of them is protonated at N3 at acidic pH and/or silver ion. However, at basic pH, they form single stranded structure. We measured the chemicophysical interactions between poly-C DNA in acidic/basic medium and Ag+ ions. It is found that Ag+ ions have high-affinity binding among cytosines through high unbinding force in acidic conditions and $100\,\mu M$ of Ag+.

P3-14 유전영동힘분광기를 위한 LabVIEW 기반 조절 가능한 자동 단계별 힘 인가 시스템 구축

김민형, 고관휘, 최승엽, 이세영, 이상우
연세대학교 의공학과 나노바이오시스템 연구실

We have developed LabVIEW-based automatic force step loading rate system in dielectrophoretic force spectroscopy that could be utilized for controlling input voltage rate, namely subdivision of force loading rate. Then we have analyzed intermolecular binding interaction by 'grayscale method', and these are converted into mean binding force. We have verified the synchronization between step interval time and charge-coupled device capture rate through light-emitting diode circuit. In this program, the experiments have been performed with adjusting various step conditions at the same force loading rate. We have observed that as the number of steps change, the mean forces are equally measured.

P3-15 유전영동기술을 이용한 세포의 약물반응 분석

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KAIST 바이오 및 뇌공학과

Quantitative analysis of cellular responses of living cells is highly important in investigation of cell-to-

cell signaling and evaluation of novel drugs in nano-medicine. In this study, we demonstrate that the microfluidic dielectrophoretic (DEP) chip enables simultaneous detection of cellular responses of live B16F10 melanoma cells to small molecule drug such as N-ethylmaleimide (NEM) and [(dihydronindenyl)oxy]alkanoic acid (DIOA), which are attributed to activation or deactivation of K+/Cl- co-transporter (KCC) channels on the cell surface by the small molecule drug.

P3-16 나노다공성 필터를 이용한 마이크로베지클 분리

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Exosomes are derived from a multitude of cell types, and perform diverse cellular functions including intercellular communication and antigen presentation. Interest about liposome for using clinical application has rapidly increased, therefore techniques to separate exosome without cell damage are required. In this paper, we suggest a separation of exosome occurred by diffusion as a result of molecules Brownian motion with 2D Nano-pore membrane. This technique is allowed to acquire a non-damaged exosomes after separation.

P3-17 Formulation of a smart released nano particulate HPMC drug delivery system (Cell Binder®) containing mussel adhesive proteins (MAPs) and investigating its rheological, thermal and erosion behavior for use in the treatment of periodontal disease and tissue regeneration

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We formulated of a nano particulate Hydroxypropyl Methylcellulose (HPMC) drug delivery system (Cell Binder®) based on a mixture of HPMC, and mussel adhesive proteins (MAPs) and in vitro release of dental drugs from the sustained released Cell Binder® in a physiological condition. The present study introduces erodible insitu forming gel systems as potential vehicles for prolonged release of drug contained this smart DDS. Cell Binder® was prepared by solidification of an oil-in-water microemulsion containing MAPs, stearic acid, surfactants and co-surfactants. Nanoparticles were then dispersed in a thermosensitive HPMC aqueous solution (sol) at 4°C and their effects on gel forming ability, sol-gel transition and rheological behavior of the system were investigated over 5-50°C. Thermal behavior of the system was investigated by differential scanning calorimetry too. Erosion rate of the gel in the presence and absence of Cell Binder® was measured by gravimetric method. Integrity of Cell Binder® in the system was investigated by scanning electron microscopy (SEM) and particle size analysis. SLN showed particle size and zeta potential of 130±1.39 nm and -44±2.1mV respectively. Particle size analysis and SEM studies after gel erosion revealed presence of intact Cell Binder® in the hydrogel. Cell Binder® reduced erosion rate of HPMC gel and increased its sol-gel transition temperature from 26 to 29°C. However, gelling kinetic did not change significantly after addition of Cell Binder®. Damping factor ⟨1 indicated stability of the MAPs-containing system.

Present results indicate potential of sol-gel systems for controlled nanoparticle delivery and show that Cell Binder® affects properties of the system.

P3-18 비타민 C의 단백질 섬유 합성 저해 효과

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Although vitamin had been widely used and proposed as a tool of prevention and treatment of disorders (e.g. mood disorder and cancer), this effect of vitamin C is still unclear. In recent, it had demonstrated that vitamin C is of importance not only to treat the degenerative diseases such as Alzheimer's and Parkinson's diseases but also to hinder the formation of amyloid plaque. However, inhibition effect on formation of protein fibrils in vitro remains uncertain. Herein, we investigate the retardation effect of vitamin C against formation of protein fibrils by using a high-resolution atomic force microscopy and fluorescent assay.

P3-19 멀티 리간드가 부착된 약물전달 입자의 결합 특성

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Drug delivery system based on nano/micro particles is one of the promising techniques for treating cardiovascular diseases or cancers. It is of great importance for the particles to be attached to the diseased cells specifically. We selected multi-ligand interaction model for the specific targeting. There are some crucial factors in the adhesion of the particles to the cells, for example, the receptor density of the cells, the ratio between each ligand's specific parameter, the ligand-receptor kinetic binding affinity, and so on. In this research, it is shown that how much

these factors contribute to the particle adhesion probability.

P3-20 Miniaturized Scalp-Implantable Antenna for Wireless Biotelemetry

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In this study, we present a scalp implantable miniaturized biocompatible antenna at the medical implant com- munication service (MICS) band (402-405 MHz). The antenna dimension is only 26.4 mm3 (11 mm x 8 mm x 0.3 mm) which is an electrically small antenna. It provides a monopole like radiation pattern with radiation efficiency of 1.9%, -10dB impedance band- width of 42MHz and gain of -42.21 dB. These results are achieved when it is implanted in skin tissue of a human head model at 5mm depth. To reduce simulation time, initially the antenna was placed in a skin tissue simulating box of 5mm implant depth. For simulation in skin tissue box, Ansoft's EM simulator HFSS and for human head implantation, SEMCAD X FDTD software was used.

P3-21 골드나노파티클을 이용한 저가형 SERS 종이 기판 플랫폼

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We introduce to fabricate the SERS platform using AuNPs and viscous ink by a screen printing method, in this work. The SERS effect was adjusted by the amount of synthesized AuNPs and the distribution of AuNPs were controlled to find the appreciate viscosity of screen printing inks using the CMC solution

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for the high reproducibility of the SERS. The SERS platform on paper was optimized five cycles of a 7:1 CMC-AuNPs ink solution. The proposed SERS paper platform showed the noise-independence, uniformity, and reproducibility of SERS spectral signals. This finding suggests that the proposed SERS assessment has the potential to be used as a highly sensitive and selective assessment for biological fluids.

P3-22 자가 조립식의 균일한 플라즈모닉 나노 입자 배열

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For the optimization of optical properties for plasmonic sensor, it's a major factor to control shape, size, and structure materials of nanoprobes. Although already exist lots of the fabrication methods for nanoprobes array, most of them are quite expensive and complex ways. Here, we demonstrated the easy way of fabricating uniform nanoplasmonic probes array. In first, we deposited the closed-packed monolayer of polystyrene (PS) nanospheres onto the Au-Ag nanofilm, and then PS nanospheres were etched with oxygen plasma to shrink until their size was under 300 nm. A dry etching was applied onto the substrate. During dry etching, the shrunk PS beads served as the mask, and then the metal film below the shrunk PS beads was maintained. Finally, after removal of PS mask and thermal annealing process at a high temperature about 500℃, the uniformly ordered heterogeneous nanodot array was self-assembled.

P3-23 온도 센서 교정이 PCR 칩 성능에 미치는 영향

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The fabrication of microfluidic channels in previously proposed polymerase chain reaction chips by using polydimethylsiloxane, polycarbonate, and poly (methyl methacrylate) is expensive. To reduce the cost of the disposable chips, a polymer film is employed on the PCB substrate for the bottom, and a carved double-sided tape is for the wall, and a film with inlet and outlet holes is for the ceiling of the reaction chamber. The chip temperature is controlled by the heater pattern of the substrate and the thermistor on the opposite face. The commercial chip thermistors with 1% resistance tolerance are adapted. In this paper, the effect of the thermistor calibration on the PCR performance is investigate. Comparison results on the band brightness of gel images will be given

P3-24 Micro-PCR 칩 NTC-Thermistor 센서 교정 시스템

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본 논문은 정확한 온도 측정 및 제어를 요구하는 Micro-PCR 시스템에서 Micro-PCR 칩에 부착된 NTC-Thermistor 센서의 정확한 온도측정을 위한 교정계수 값 측정 시스템을 구현했다. 교정계수 값을 구하고자 하는 Micro-PCR 칩은 정확한 온도 측정을 할 수 없기 때문에 간접적으로 히팅-패턴을 가열해야 하며, 각 4 구간의 목표온도에 도달했을 때, 교정계수를 구하고자 하는 칩의 센서로부터 저항 값을 측정해야 한다. 미리 교정된 Micro-PCR 칩의 히팅-패턴 위에 열 전달을 위한 알루미늄 조각을 서멀-테이프로 부착한다.

교정하고자 하는 칩의 히팅-패턴 위에 알루미늄 조각과 최대한 압착시켜 미리 교정된 칩을 통해서 간접적으로 히팅-패턴을 가열 한다. 각 4 구간의 목표 온도에 도달했을 때, 교정할 칩 센서의 저항 값을 여러 차례 측정 후, 그 평균 값들을 구한다. 결과적으로 각 4개의 평균된 저항 값들로 Armadillo 라이브러리를 통해 3개의 교정계수 값들을 구할 수 있었으며, 칩에 부착된 EEPROM 메모리 칩을 통해서 교정계수 값을 기록하고, 다시 칩으로부터 교정계수 값들을 읽고 온도교정을 할 수 있었다. 기존 항온수조를 이용한 교정 시스템은 각 목표 온도구간에 도달하기 위해 긴 소요시간이 필요하다. 하지만 본 논문에서 제안된 교정 시스템은 각 목표온도에 도달하기 위한 소요시간이 짧으므로, 기존 교정 시스템에 비해 교정 작업 시간이 줄어드는 결과를 확인할 수 있다.

P3-25 신경유사세포의 신경돌기 성장을 위한 나노우물구조의 표면 제작

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The nanostructured surface comparable to the feature of extracellular matrix (ECM) has been known for influencing a cellular responses, such as adhesion, differentiation and neurite outgrowth. These surfaces containing nanostructures capable of minutely stimulating cells can be positively utilized in the implantable devices for providing the favorable interface with cells or tissue. In this study, nanowell surface was fabricated using nanosphere lithography technology. This nanowell structured surfaces without any cell adhesive substance demonstrate the neurite outgrowth of the neuron-like cell, while bare flat surface results in no neurite outgrowth.

P3-26 성게 구조를 갖는 Fe3O4@Au 코어@쉘 나노입자의 광열 및 자화열 효과에 관한 연구

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The purpose of study is to investigate the photothermal and magnetothermal effect of the urchin-like Fe3O4@Au core-shell nanostructure. Fe3O4 magnetic material, heat is generated by the rotation of the magnetic moment and the self-rotation of the nanoparticles in the magnetic field formed by the RF field, which is called the magnetothermal effect. In the case of gold, heat is generated by the collision of fast moving resonant free electrons with atoms of under the light of the wavelength of the Surface Plasmon Resonance, which is called the photothermal effect. The urchin-like Fe3O4@Au core-shell nanostructure has the structure coated with gold on the Fe3O4 nanoparticles having a magnetothermal, so it is expected to have both the photothermal and magnetothermal effect. With these two effects, it would be a new technology that can treat more effectively than cancer treatment technology using the single effect.

P3-27 암실조건에서 ZnO 나노입자의 항균 메커니즘에 관한 연구

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The antimicrobial mechanism of Zinc oxide nanoparticles has been investigated. There are various mechanisms; the Three most common are the production of H_2O_2 from oxygen vacancy in the surface layer of ZnO crystals, the generation of zinc ions from the dissolution of ZnO nanoparticles and the interaction between ZnO nanoparticles and cell wall. However, antibacterial mechanism under dark condition is poorly understood and it is still under debate so far. In this study, we investigate antimi-

crobial activity of three kind of ZnO, ZnO nanoplates (NP), ZnO nano-assembly (NA), ZnO conventional nanoparticles (CN) with different particle size and oxygen defect sites. Eventually, we found that antibacterial activity of the ZnO nanoparticles under dark condition was caused by the zinc ions dissolved from ZnO nanoparticles attached on the bacterial cell wall.

P3-28 형상이 다른 금나노막대의 광열효과 비교에 관한 연구

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Gold nanorods (GNRs) grown anisotropically along the [001] direction have been extensively studied during the past decade because of their biocompatibility and excellent plasmonic responses. In particular, longitudinal surface plasmon resonance (LSPR) along the elongated axis of the GNR strongly exhibits around the near infrared (NIR) wavelength region depending on aspect ratio that well defined plasmonic property of the GNR provides the new challenge in photothermal theragnostics. Herein, we successfully synthesized the two different GNRs with the elongated cubic shape and dog-bone shape and then explored their photothermal efficiency under the NIR light irradiation.

P3-29 은 나노입자가 결합된 ZnO nanoplates 의 개발 및 항균성에 관한 연구

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Zinc oxide (ZnO) is one of the most promising antibacterial materials because ZnO is relatively biocompatible and it has a broad antimicrobial activity to both gram-negative (Gram (−)) bacteria and gram-positive one (Gram (+)). In addition, silver (Ag)

nanoparticles are well known as good antimicrobial agent. Herein, we successfully synthesized ZnO nanoplate (NP) decorated with Ag nanoparticles (hereafter referred as ZnO NP@Ag) and then study on synergetic antibacterial effect of the as-prepared ZnO NP@Ag nanocomposites.

P3-30 플라즈몬 포획 기반의 표면 증강 라만 분광법을 통한 분자 탐지

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고려대학교 바이오의공학부

Owing to novel metal's optical properties, the novel metal nano structures with short structure-to-structure distance have huge field enhancement leading to extending the detection limit to nano-unit, which is important to detect biomolecules connected to verify biological and chemical mechanisms. Here, we applied 50 nm colloidal solution with the target biomolecules into nano bowtie patterns. Where the light incident on the substrate, then 50 nm gold nano paritcles are trapped between patterns by plasmonic trapping. As a result, the structures with the short structure-to-structure distance are fabricated as the enhancement occurs, and the target molecules are also detected just at the same area lighted.

P3-31 암의 조기 및 예후 진단을 위한 표적 히스톤 라이신 메틸효소 SUV420H2에 대한 기능 분석

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Suppressor of variegation 4-20 homolog 2 (SUV420H2) is a histone lysine methyltransferase that metylates

histone H4 lysine 20. It mainly functions in pericentric heterochromatin regions, thereby playing a central role in the establishment of constitutive heterochromatin in these regions. In this study, quantitative RT-PCR and microarray expression profile analyses demonstrated that SUV420H2 expression is significantly higher in various types of cancer tissues than in corresponding non-neoplastic tissues. Additionally, qRT-PCR and multiple-tissue northern blot analyses showed that expression levels of SUV420H2 in normal tissues and cell lines are notably low. Importantly, knockdown of SUV420H2 expression using specific siRNAs induced the strong suppression of growth in various kinds of bladder and lung cancer cell lines, which implies that SUV420H2 may play a crucial role in the growth regulation of cancer cells. Furthermore, we conducted Affymetrix's GeneChip analysis and identified downstream genes and signal pathways related to human carcinogenesis, regulated by SUV420H2. These data indicate that SUV420H2 may be an important target for cancer therapy.

Neural Engineering

P3-32 전기화학법을 이용한 뇌신경전달물질 기 저농도 측정기법 개발

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Fast-scan cyclic voltammetry (FSCV) technique with carbon-fiber microelectrodes (CFMs) has been widely used for detecting electroactive neurotransmitters in vitro and in vivo. However, FSCV in vivo still has problems due to complex voltammograms, influenced by pH transient, changing nonfaradaic background current. Specially, the most of signal is consist of unwanted nonfaradaic current, therefore, it is subtracted by background subtraction method. Thus FSCV can detect the change of current occurred from electroactive neurotransmitters. However, background subtraction method cannot measure the basal concentration of neurotransmitter because it is buried in background signal. In this research, we proposed new type of FSCV for measuring tonic concentration of neurotransmitter. By minimize background signal, we were able to detect the presence of dopamine in solution in vitro and also in vivo.

P3-33 국지 정보와 가우시안 혼합 모델을 이용한 간질성 발작 검출

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This study aims to propose a new methodology to detect an epileptic seizure using brain signals. So far, many nonlinear models have been often used to assure high accuracy of detection. However they suffer from long computational time and complexity. To overcome it, we develop a computational algorithm to sustain high accuracy as well as low computational loads. Our proposed model consists of exploiting local spectral information in EEG using a Gaussian-mixture model followed by the Native Bayesian classifier. We could classify between normal state and epileptic seizure states with average accuracy of 90 ± 5 %. Hence, our low-weight model may be suitable to real-time detection of epileptic seizure.

P3-34 전자모듈 이식체가 필요 없는 인공 달팽이관 시스템에서 인덕티브 링크간 거리를 측정하는 회로

김채빈, 엄경식, 정준수, 권태묵, 최광진, 김성준
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POSTER III

This paper concerns a low cost cochlear implant that requires no active electronics to be implanted as Wilson et al. presented in 1998. This device has benefit of low manufacturing cost and simplified encapsulation problem, yet suffers from unpredictable performance when the distance between the implanted coil and the external coil changes. In this study, we designed the circuit to measure the distance between coils to overcome this susceptibility. Also we verified the efficacy of the design by measuring distance between coils outside of the body.

P3-35 금 나노 입자를 이용한 배양한 해마 신경의 근적외선 신경 자극

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Cellular modulation with light has gained its popularity due to its merit of high spatial resolution and non-invasiveness. Recently, gold nanorods mediated infrared neural stimulation have been proposed as a safe and effective neural stimulation method. However, this work has been performed in peripheral nerve. In this paper, we cultured hippocampal neuron on microelectrode array. We found that photothermal effect of gold nanorods could efficiently elicit neural activation.

P3-36 금 나노선 전극을 이용한 생체 내 신경신호 기록

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Single crystal gold nanowires (100 nm in diameter) has unique mechanical and electrical properties. The depth-type neural probe containing the ultra-thin gold nanowire at the tip can minimize reactive glial responses, which is a promising for long-term neural recording applications. In this study, we propose a single channel neural electrode attached with the gold nanowire at the tip of an insulated tungsten wire. The electrode characteristics were investigated for implantation into the rat brain cortex and individual neural spikes were detected..

P3-37 SSVEP 기반 BCI를 이용한 증강현실 시스템에서의 타겟 선택 기술

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In this study, we implemented a hand-free target selection method for augmented reality devices such as Google glasses and see-through display. Steady state visual evoked potential (SSVEP) recorded at visual cortex of users was used to select a specific target the user was concentrating on. In our system, a user could turn on the augmented reality device mounted in front of the user's eyes by blinking his/her eyes three times per two seconds. The augmented reality device (a small tablet PC in this study) detected a number of candidate targets (human faces in this study) and generated flickering visual stimulus for each target. EEG recording system then selected one of the candidate targets, and provided specific information on the target or generated additional commands to operate the selected target. Our preliminary experiments showed that our system has the potential to be used in practical scenarios.

P3-38 자극 모양 및 밝기 변화를 통한 이중주파수 SSVEP 및 P300 유도

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We propose a hybrid stimulus that varies in light intensity and shape simultaneously to evoke dual-frequency SSVEP and P300 potential. The proposed stimulus flickers at a SSVEP frequency and presents characters at a P300 frequency, where the SSVEP frequency is harmonic of the P300 frequency. The hybrid stimulus enhanced SSVEPs and increased the number of commands by employing harmonic flick-ering frequencies. Additionally, the hybrid speller re-duced the number of flashes from twelve (row-column paradigm of P300 stimulus) to four (the hy-brid stimulus), reducing stimulation time. The pro-posed hybrid stimulus is expected to yield a more reliable and more time-efficient BCI system.

P3-39 ALS 환자를 위한 움직임 기반의 뇌-컴퓨터 인터페이스의 1년 추적 연구

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The aim of this study was to investigate the EEG characteristics of ALS patients how to change during progression of disease and to classify four different movement tasks using electroencephalogram of ALS patients. The self-paced experiment was performed in virtual environment and feedback was given based on automatic EMG detection. One ALS patient participated in this study 6 times at an interval of 2 months. Common spatial patterns (CSP), spectrally weighted CSP and filter-bank CSP was applied to extract features, and linear discriminant analysis (LDA) was applied to classify motor execution tasks. BCI performance and medical research council sum score seems to be correlate.

P3-40 생물학적 표본의 저온보관을 위한 열전소자 제어회로

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Recently, biological samples are widely used in the biotechnology research. However, biological samples are prone to be deformed in a room temperature. In this paper, we suggested a novel, simple circuit which controls TEC for cooling biological samples. A thermistor and comparators were used to detect whether the temperature is within the acceptable range and TEC was used to cool down to the de-sired temperature. We demonstrated that the TEC cools the system to a set temperature value of 6℃.

P3-41 액정폴리머 기반의 무선 신경 자극 장치에서 코일의 상대적 위치에 따른 전력 수신 효율

안승희, 이성은, 엄경식, 정준수, 김성준
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Miniaturization of implantable packages with wire-less power transfer is one of the essential techno-logies for implantable neural stimulators. Previously, we have reported a liquid crystal polymer (LCP)-based implantable neural stimulator powered via wireless inductive link. The LCP-based device is integrated with LCP multilayers such as the coil layers and the electric circuit layer. The location of the coil layer can affect the power transmission efficiency with the external transmission coil. In this study, over different RF frequencies, the power trans-mission efficiencies were measured depending on the different positions of the coil layers and the electric circuit layer.

POSTER III

P3-42 나사 전극의 유효성 검증

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Recently, several studies have reported the usability of epidural electrocorticogram for brain computer interface. However, there are some limitations on conventional patch ECoG by acquisition brain activity in local area. In this study, we suggested a new screw ECoG and verified the feasibility with a dog's and a monkey's visual evoked potentials. As a result, there was no significant difference between conventional patch ECoG and screw ECoG, which reflected that this could be another option for brain computer interface.

P3-43 마취 시 샘플 엔트로피를 이용한 뇌파 분석

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Electroencephalogram (EEG) is a measurement for electrical neural activity in brain. Due to the fact that EEG can reflect brain state, it is generally used in clinical area, especially anesthesiology. In anesthesiology, monitoring the depth of anesthesia is important. Therefore, extracting parameters which indicate the depth of anesthesia has been an interesting issue. Neural system has nonlinear behavior so that the use of nonlinear analysis method is appropriate. Sample entropy is one of the nonlinear analysis methods indicating complexity and irregularity of data. Accordingly, we utilized it as a parameter indicating brain state depending on the anesthesia concentration.

P3-44 장기간 사용 가능한 Parylene-filled PDMS 기반의 생체 삽입 형 전극

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In this paper, we applied the parylene-filled PDMS as the substrate of neural electrodes to overcome the shortcomings of PDMS and parylene. Parylene-filled PDMS has beneficial mechanical properties, which is similar to PDMS, and low water absorption because the particles of parylene are trapped in the porous PDMS surface. To evaluate the electrical stability of the electrodes based on parylene-filled PDMS, we conducted the electrochemical impedance measurement and compared its impedance change with impedance change of the electrodes based on native PDMS over 5 months. The results showed the impedance of parylene-filled PDMS was more stable than that of native PDMS.

P3-45 실크를 이용한 인공 와우 전극 설계

최광진, 박정환, 권태목, 김채빈, 김성준
서울대학교 전기·정보공학부

These papers concern a new cochlear implant electrode that can change shape once it is inserted into the cochlear, from straight to spiral shape. Silk fibroin, biodegradable material, is stiff in the air but is dissolvable in the solution. The new cochlear electrode maintains straight shape outside the body with silk coating and returns to spiral shape when inserted in cochlea.

P3-46 ECoG를 이용한 측두엽에서 알파파의 공간상 전도 분석

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Recently, cross-frequency interactions between the phase of alpha band activity and amplitude of gamma band activity. Additionally spatial propagations of cortical activity have been studied. Ali Bahramisharif et al.(2013)[1] investigated that gamma power is phase locked to traveling alpha waves. In this study, we also demonstrated traveling alpha waves and related two difference phase locked gamma power activities on left temporal region using the same methods of [1].

P3-47 서울형 인공 망막 시스템을 위한 자극 패턴 생성기

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Retinal prosthesis is an implantable device for restoring vision of the blind patients suffering from retinal diseases such as age-related macular degeneration and retinitis pigmentosa. Recently a Seoul retinal prosthesis using a novel biomaterial of liquid crystal polymer was developed and its performance is being evaluated. In order to verify the operation of this device and to readily control the retinal stimulation parameters (pulse amplitude, duration, rate), a stimulation pattern generation program is developed using Visual Basic for graphic user interface (GUI). The operation of the program was verified by setting the values of pulse rate, duration, amplitude, and the sites of channels and confirming the generated stimulation pulses from retinal stimulating circuit having the intended parameters.

P3-48 3차원 배치의 채널을 갖는 액정폴리머기반의 신경 전극

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To date, there were many studies of three-dimensional neural probes with multi-channels and multi-shanks. However, most of them had channels on one side of the shanks. Although there was an attempt to make neural probe with three-sided electrodes, the fabrication process was complex. Using liquid crystal polymer(LCP), we made neural probe with four-sided contacts through simple lamination process. It has three-dimensional composition of sites, therefore it can record neural signals from multiple brain tissues simultaneously.

P3-49 신경신호 기록을 위한 탄소섬유 기반의 미세전극어레이

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Microelectrode arrays are commonly used to record the neural activities in the brain or to make a neuronal interface between brain and machine. However, the traditional system often induces tissue reaction around the electrode array, thereby limiting the possibility of long-term experiments. It is believed that the extent of tissue damage is associated with the geometrical size of the electrode. In this study, we introduce the multi-channel microelectrode array whose channels are composed of carbon fiber bundles and show the preliminary neural responses recorded in motor cortex area of anesthetized rat. Since the diameter of the carbon fiber (7 μm in diameter) is much smaller than the conventional micro-wires, we anticipate that the proposed electrode array could be appropriate for the long-term neural recording.

P3-50 초음파 자극에 의한 배양된 신경세포의 장기 활동도 변화

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Ultrasound is becoming a favorable neuromodulation method due to the noninvasiveness and the high spatial resolution. In the previous study, we showed that the low-intensity, low-frequency ultrasound (LILFU) stimulation increases the frequency of spontaneous neuronal activity using cultured neurons. In the present study, we examined the long term potentiation (LTP) effect of ultrasound on the hippocampal neurons cultured on microelectrode arrays (MEAs). Repeated ultrasound stimulation increased the frequency of action potentials and the increased activity remained even after 20 min resting time in the absence of ultrasound stimulation. In order to examine the synaptic change after ultrasound application, in addition, immunocytochemistry was performed.

P3-51 영화 시청 시 감정 상태에 따른 신경동 기화의 차이

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연세대학교 의공학과

In this study, we investigated the differences in neural synchronies among the different emotional states during watching movies using time-frequency analysis of event-related electroencephalograms (EEGs). In both valence and arousal levels, significant differences in neural synchronies were observed in gamma-, beta/alpha-, and theta-band at frontal, centro-parietal, and occipital regions, respectively. In addition, the spectral powers showed significant differences were significantly correlated to the self-assessment emotional levels to the movies.

P3-52 구심성 및 원심성 근수축 시 감마대역 신경 동기화 특성 차이

차광수[1], 최정우[1], 박주희[2], 전혜선[2], 김경환[1]
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We investigated the differences in local and global neural synchronies in gamma-band between concentric and eccentric muscle contractions. At the movement duration, significantly increased local and global neural synchronies in gamma-band were observed in eccentric contraction compared to those for concentric contraction. Our findings suggest that different types of muscle contractions were modulated by different levels in neural system.

P3-53 fMRI영상 기반 뇌 네트웍 분석을 위한 기능적 연결성 분석방법들의 비교

이태윤, 최현정, 신정희, 정영진
동서대학교 방사선학과

Brain network analysis based on functional Magnetic resonance imaging (fMRI) data is of great clinical importance for understanding mechanism of neural diseases and brain activity. However, most fMRI data were measured with under 0.5Hz sampling rate, thereby limiting utilization of various developed network estimators. In this study, the three kinds of causal estimation approach was introduced to estimate the connectivity and causality for fMRI data. To validate the each performance of causal estimator, the computer based Monte Carlo simulation using fMRI mimicking signals was conducted by various realistic conditions. The simulation results show that the analytic causal estimator can estimate connectivity more accurately than other methods.

P3-54 파킨슨씨 병과 수전증에서의 체위성 진전 비교

전효선[1], 이홍지[1], 김상경[1], 김한별[1]
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The purpose of this study is to characterize postural tremor with no resting tremor in essential tremor (ET) and Parkinson's disease(PD). Postural tremor without resting tremor in both disease was acquired using three-axis-accelerometer. We calculated approximate entropy to compare postural tremor in two groups. The mean value of ApEn in ET and PD was 0.577 and 0.655 respectively, which was significant (p<0.05) using ANOVA. This may have a potential for a characteristic of postural tremor.

P3-55 Capacitor-coupled adenosine measurement using Fast-Scan cyclic voltammetry to clarify adenosine feature

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Electrochemical neurotransmitter sensing technique, Fast-scan cyclic voltammetry (FSCV) using carbon fiber microelectrode have been used in electroactive neurotransmitter study, such as catecholamine mechanism. However, adenosine measurement using FSCV has pattern-decaying problem caused by its usage of large peak potential, and it can be reliability problem since its changing pattern after adenosine exposure makes precise estimation of concentration harder because size of the adenosine pattern is directly related with its concentration. In this study, we tried to solve pattern decaying problem by using additional capacitor serial connection with working electrode. It

can prevent radical increase in working electrode's double-layer capacitance, reducing its large peak potential.

P3-56 이식형통증완화전기자극장치의 국제조화된 기준 및 시험법 마련 연구

김산[1], 이선연[1], 황윤수[1], 박상건[1], 박수강[2]
김용균[2], 이창형[1], 김혁주[1], 서경원[1]
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The test methods for the implantable neurostimulator, which is a human-transplant electric medical device, were developed through this study. By investigating the constitution, functions, operating principles, domestic licenses, FDA guidance and international standards (ISO 14708-1, ISO 14708-3, IEC 60601-1, IEC 60601-1-2, EN 6788-2) of an implantable neurostimulator, 11 kinds of safety-related test items and test methods were derived and the test research was further proceeded on 9 test items among them. As a result of the test research, suitability of the derived test items was confirmed, and the test items, standards and test method, which conform to international standards and are suitable for domestic situations, were finally prepared.

P3-57 기억 향상에 심부뇌자극의 치료효과 기전: 콜린성 혹은 가바성 신경의 직접적인 활성 대 신경발생에 의한 간접적인 복원

정다운, 이지현, 장원석, 장진우
연세대학교 의과대학 신경외과

The possibility of deep brain stimulation (DBS) on memory enhancement is recently reported, but the mechanisms underlying its effects are not precisely understood. This study was performed to confirm the effects of medial septum deep brain stimulation on

memory impairment by cholinergic deficit. To find the affected stage of memory, stimulation is delivered in the different time.

P3-58 자극빈도와 외부소음크기에 따른 모음 인지력 평가

양혜진[1], 강수진[1,3], 진선화[3]
문일준[2,3], 홍성화[2,3], 우지환[1]

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Vowel identification ability of cochlear implant users is influenced by various stimulation settings or speech processing strategies. In this study, we assessed vowel identification ability by stimulation rate per channel and background noise level for cochlear implant users. In addition, we assessed vowel identification ability using computational evaluation method. But the stimulation rate per channel didn't affect vowel identification ability, though the background noise level affected vowel identification ability. The results for cochlear implant users is similar to that for the computational evaluation method. So, the computational evaluation method can be used to assess vowel identification ability objectively.

P3-59 In Vitro 촉각 수용체의 활성화를 위한 자극장치 제어

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[1]한양대학교 의공학교실, [2]한양대학교 생리학교실

To investigate the neural mechanism of mammalian touch in vitro recording from skin nerve preparation is used conventionally. For a repeatable response, a stimulation including an accurate pressure and precisely designed waveform is required. However, it has to be optimized thoroughly as the skin compliance is different to each receptive field and a weak pressure

of several mN is enough to activate low-threshold-mechanoreceptors. Therefore, we have introduce a solenoid stimulator with a pressure feedback. Using the stimulator we optimized the controlling parameters and enabled various type of waveform: rectangular, sinusoidal, and ramp-and-hold. As a result, characteristic activation of slowly adapting and rapidly adapting mechanoreceptors were obtained. Based on the patterns, more complex stimulus waveform assuming textures would be possible.

P3-60 진동 자극 인가에 의한 쥐의 촉각 수용체의 발화특성 연구

최정봉[1], 조경원[1], 장준호[2], 정승준[2], 김인영[1], 장동표[1]
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There are various receptor types or free nerve endings underneath skin. Human tactile sensation is basically a combination of these receptors-specific neuronal activities. In this study, therefore, we aim to find spiking patterns of afferent fibers according to mechanoreceptor types by using finely controllable mechanical stimulation. We configured the database of afferent fiber's spiking patterns associated with stimulation parameters (frequency, duration, and so on) and setup the basic principles and resources for the development of tactile display in the future.

P3-61 Acoustic Change Complex에 기반한 와우 소실 영역 검사의 객관적인 방법 제시

강수진[1,2], 문일준[1,3], 박희성[1]
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Damage to the inner hair cells and/or neurons results in hearing loss, where is called the cochlear dead region (CDR). Recently, a pure-tone test in the presence of threshold-equalizing noise (TEN) was in-

troduced to identify CDR. However, this subjective method cannot be used for uncooperative persons, so there is a need to develop the objective measurement of the CDR. The acoustic change complex (ACC) is an evoked potential elicited by changes in ongoing sound. In this study, we developed TEN-ACC test to present preliminary TEN-ACC data and to evaluate the use of TEN-ACC as an objective tool to detect CDR.

P3-62 척수손상 이후 감각운동 네트워크에서 기능적 연결성의 변화

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The hypothesis of this study was to use resting-state fMRI to investigate a change of functional connectivity of the sensorimotor network after SCI. A seed-based method was used to determine the resting-state functional connectivity. The results of individual functional connectivity maps from the M1 seed were used for within-group analysis. Our resting-state fMRI study demonstrated neuroplastic changes in resting-state functional connectivity in the sensorimotor network after SCI. Specifically, connectivity increment is observed between the motor components, whereas sensory components decreased connectivity within the sensorimotor network.

P3-63 기능적 자기공명 영상을 이용한 망간 노출군의 위스콘신 카드 분류검사에 따른 뇌 활성도 변화

차현실[1], 서지혜[1], 장경은[1], 장용민[1,2,3]
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[3]경북대학교병원 영상의학과

A large number of research has been noted to identifying brain function's abnormalities in welders by manganese poisoning. We investigate the effect of chronic exposure by welders to manganese through an analysis of the degree of dynamic neural changes and brain activities such as cognition and executive function using the Wisconsin Card Sorting Test (WCST).

P3-64 다중생체신호 기반 영화 시청 시 감정상태 디코딩

최정우, 최종두, 김경환
연세대학교 의공학과

In this study, we tried to decode the emotional states during watching movies using multimodal biosignals. Multi-channel electroencephalograms (EEGs), skin temperature, Galvanic skin response (GSR), and photoplethysmogram (PPG) were recorded from healthy participants during watching movies which were categorized into four types of emotional states based on the valence-arousal (V-A) model. Features showing significant difference among emotional states were selected from all signals to reflect each emotional state. The trained classifier showed that the best decoding accuracies were 89.61 % for valence level using combined modalities and 79.59 % for arousal level using EEGs only.

P3-65 골격화 알고리즘을 이용한 개별신경세포 영상의 자동분석방법 개발

정혜선, 이지선, 황서영, 전상범
이화여자대학교 전자공학과

A new method is proposed to automatically analyze the morphology of individual neurons cultured in vitro. The morphology of neurons can be used as a measure for cell-based biosensors or neuroscience

studies. Previously, most of the detection algorithms for neuronal morphology have been manual or semi-automatic, which are not suitable for analysis of massive image data and lacking the detection precision for fine cellular structures. Therefore, the present study propose a more accurate and faster detection algorithm applying the skeletonization algorithm. The proposed algorithm is assessed compared with a previous method using the likelyhood ratio test algorithm.

P3-66 측정 자세에 따른 파킨슨 트레머와 본태성 트레머의 특징

이홍지[1], 이웅우[2], 전효선[1], 김상경[1]
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There is a clinical limitation on discrimination between parkinsonian tremor and essential tremor accurately by visual inspection. 22 patients with parkinsonian tremor or essential tremor participated in the clinical test. Tremor was measured using 3-axis accelerometer on the finger and wrist of both hands. Tremor severities were rated by two clinicians using clinical tremor rating scale (CTRS). A ratio of root mean square from rest task to that from postural task on finger and wrist was used as a parameter to discriminate tremor types. The ratio of parkinsonian tremor was higher on both finger and wrist than that of essential tremor.

P3-67 안구전도를 이용한 실시간 숫자 입력장치

차호승, 임종엽, 전다솔, 장원두, 임창환
한양대학교 생체공학전공

There have been attempts to develop assistive human computer interface (HCI) technologies for the disabled having trouble communicating with others. Camera based eye-tracking is one of those technologies, which is an assistive input device without using hands. The camera based techniques, however, have their limitations as well. Head-mounted camera may obstruct the users' field of vision, and high-quality cameras which can be hidden from the vision are expensive. The electrooculography (EOG)-based eye tracking is a substitute for the conventional approach to address this issue. This study suggests a real-time EOG-based digits input device to distinguish digit patterns (from 0 to 9) by analyzing EOG signal in 3x2 resolution. The classification accuracy in digit patterns was 91.67% in offline test and the test was conducted and successfully completed in a real-time environment, which demonstrates the possibility of practical use of our system for the motor-disabled users.

P3-68 실시간 눈 깜빡임 검출을 위한 개인별 임계치의 자동조절방법

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한양대학교 생체공학전공

This study introduces an automatic thresholding technique to detect eye blink artifacts contaminating EEG signals. The proposed method for the automatic detection of eye blink artifacts does not require any labeled training data, and thus the system can be more readily applied to practical applications including wearable EEG systems. The performance of the proposed method was compared with those of conventional automatic thresholding algorithms.

P3-69 색체 자극을 이용한 정상 상태 시각 유발 전위 기반의 저자극 뇌-스위치 시스템 개발

임정환, 김용욱, 이준학, 한창희, 차호승, 임창환
한양대학교 생체공학전공

In the present study, we developed a steady-state visual evoked potential (SSVEP)?based brain switch system adopting a chromatic visual stimulus, which is less stimulating and thus more adequate for daily-life use. Online experiments were conducted with five healthy subjects and two patients with ALS, and the results showed that the average time needed to turn on the brain switch was 8.9 s, and the brain switch did not operate for 166.4 s while the participants did not gaze at the stimulus. Moreover, we checked the test-retest reliability for long-term use of the system, and demonstrated the possibility of our brain switch system.

P3-70 칼슘이미징을 통한 방광 평활근 세포의 활동 관찰

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The detrusor muscle which contracts to release urine is mainly composed of smooth muscle cells (SMCs). Abnormal functions of the SMCs would lead to voiding dysfunction. Because the SMC contraction is regulated by external calcium ion influx, monitoring calcium level in the cytosol is crucial to study function of the SMCs. In this study, we recorded calcium response of human bladder SMCs to muscarinic agonist, cabarchol. We showed that calcium level increased after cabarchol perfusion. In the further study, the optogenetic techniques will be applied to modulate human smooth muscles' activity for bladder control.

Tissue Engineering and Biomaterials

P3-71 TSP가 세포 생존에 미치는 영향: 2D 배양과 3D 배양 비교

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인제대학교 의용공학부

Magnetic Resonance Spectroscopy (MRS) has been being used to identify cell metabolite and differentiation with reference material (TSP). The purpose of this study is to evaluate cell viability of TSP in 2D and 3D agarose gel cell culture. MG-63 were selected and cultured at varied TSP concentration. Our results indicate that the increased concentrations of TSP effect the reduction of cell viability. However, there was no significant difference in low concentrations of TSP (0~5mM). We concluded that low concentration of TSP still can be used for MRS in 2D and 3D cell culture.

P3-72 확산접합을 이용한 이식형 신경조절시스템의 피스드루 제작

김진원, 송인호, 문진희, 유성근
문동준, 이호종, 박희원, 이승아
오송첨단의료산업진흥재단 첨단의료기기개발지원센터
제품개발부 첨단융합팀

Biologic safety of long-term implantable medical devices depends on the reliable hermetic sealing as well as biocompatibility of biomaterials. Generally, laser welding and brazing technology have been used for titanium case bonding and for hermetic sealed feed-through fabrication. However, hermetic sealing using brazing technology needs strict conditions for the high reactivity of titanium. Here, we report the diffusion bonding technology for hermetic sealed

feed-through fabrication for implantable medical devices and Pt/Au pin fabrication for diffusion bonding.

P3-73 초음파를 이용한 3D Scaffold Matrix 물질의 특성 측정

송길수, 손정우, 박진감, 신운철, 원종호
차오름, 김진호, 서종범, 김한성
연세대학교 보건과학대학 의공학과

One of methods which are cultured to increase proliferation cells by using the 3-D Scaffold Matrix. In particular, the method for stimulating the cells by using ultrasound and a 3D Scaffold Matrix has the potential to proliferate the cells. Since the prior research of cell stimulation experiments using ultrasound in this study, use of ultrasound having a 3-D Scaffold Matrix be used for cell experiment properties characteristic acoustic impedance, elastic modulus, the acoustic velocity, the acoustic attenuation coefficient of the transducer 1~4MHz by measurement, the 3-D Scaffold Matrix to identify the correct materials for ultrasonic stimulation.

P3-74 프레스 가공을 통한 의료용 티타늄 케이스 제작 및 레이저 융착

문진희, 김진원, 박희원, 유성근
송인호, 문동준, 이호종, 이승아
오송첨단의료산업진흥재단 첨단의료기기개발지원센터
제품개발부 첨단융합팀

Implantable medical devices have to be protected by medical Ti-case for mechanical, electrical, Electromagnetic safety. But, these are too expensive and hard to be manufactured by domestic industrial environment. So, we have tried to manufacture small quantity of medical Ti-case (Upper and bottom sides) for animal and clinical tests by press working. And we developed methods for welding both sides by

pulsed laser welder (Select, Rofin Inc.).

P3-75 부피바카인 서방방출을 위한 생분해성 PLGA 마이크로입자

김세나[1], 최병현[2], 박천권[1], 허범강[1], 김현구[2], 최영빈[1,3]
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To control a post-operative pain, a local anesthetic drug is often injected at the site of interest. However, this bolus drug injection is limited in its short residence time, thereby low bioavailability of drug. To resolve this, we fabricated the microparticles composed of a biodegradable polymer (PLGA), which were loaded with an anesthetic drug, bupivacaine. The strategy is therefore to release the drug in a sustained manner to obtain higher drug bioavailability at the injected site. The microparticles?were fabricated with the O/W emulsion method, which were loaded with 26.3 μg drug per mg microparticles. Then, we evaluated their in vitro drug release profile in pH 7.4 PBS. After a burst release of 34% on the first day, the drug was slowly released for more than 20 days, the period of which was expected to be long enough to suppress a major pain after surgical treatment.

P3-76 치과재료 품목별 성능평가 시험항목 선정을 위한 연구

이희성, 김형식, 이승열, 이창형, 김혁주, 서경원
식품의약품안전처 식품의약품안전평가원
의료제품연구부 의료기기연구과

Dental materials vary in kinds and materials and need a large number of tests including a performance test and a test of physicochemical properties. Although there is a general guideline on biological safety of medical devices, there is no specific guideline that can provide test items based on the contact

area and contact period of dental materials, which has caused significant difficulty for inspectors and applicants to establish performance, physicochemical, and biological safety test items. Therefore, this study aims to develop a guideline on performance test items for dental materials by selecting 30 most frequently approved items among dental materials so that test items of physicochemical performance can be established in a reasonable and scientific manner.

P3-77 나노패턴 위에서의 세포 스페로이드 형성

구건영[1], 박형준[2], 이규백[1,2]
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Understanding the interface between cell and substrate has become an issue in biomedical engineering including tissue engineering. Nano structures on a surface have been known to influence the morphology and functions of cells or tissue. Also 3D cell culture is spotlighted in cell culture because of their nature like bio-environments. In this study, we applied nano imprint lithography for fabricating nanopattern, then produce micro-pattern on the nanopattern by micro contact printing technology. Using that substrate, we cultured HepG2 cells and observed 3D cell spheroids are successfully formed.

P3-78 교모세포종의 세포 간 접촉 정도 차이에 따른 세포 표현형 변화 확인을 위한 생체 구조 모사 플랫폼의 활용

심우광, 차정화, 최경선, 김필남, 최철희
KAIST 바이오 및 뇌공학과

Glioblastoma Multiforme (GBM) is the most malignant brain tumor in adults, and highly infiltrative feature is the major obstacle to be cure. When glioblastoma infiltrates the surrounding brain spaces, glioblastoma migrates through thin, elongated structures, such as white-matter tracts. To explain the mechanism of tumor invasion and metastasis, effects of tumor microenvironment have been studied. In this article, we investigated phenotypic change by other tumor microenvironment factor, cell-cell contact difference. We applied In vitro Biomimetic Platform as cell adhesion assay tool. This study demonstrated that highly contact glioblastoma cells have more capacity to recognize topographic tumor microenvironment.

P3-79 레이저 및 광 응용 진단 및 치료를 위한 피부 모사 표준 팬텀 제조

김한나[1], 뉘엔하우[1], 채유경[1], 황지은[2], 강현욱[1,2,3]
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[2]부경대학교 의공학과, [3]해양MIBT 융복합센터

Optical tissue phantoms have been developed for in vitro human skin experiments due to various advantages such as convenience of experimental use and easiness of storage. However, it is often difficult to fabricate a thin (a few hundred micrometers) layer of epidermis. In this study, to mimic human skin tissue, we demonstrate the fabrication of a multilayer optical tissue phantom consisting of epidermal and dermal layers with 3D printing technique. By using optical coherence tomography (OCT) and inverse adding doubling (IAD) algorithm, the fabricated tissue phantoms were validated in terms of physical and optical characteristics. The proposed multi-layer optical tissue phantom can be a feasible model to indirectly evaluate tissue responses during laser irradiation.

P3-80 스킨 바이오리엑터로 확장된 전층 피부의 조직학적 분석

안선희[1], 김휘강[3], 허만일[1], 이석종[2], 최은창[3], 임정옥[1]
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POSTER III

The standard of care for skin defect replacement is the use of autologous skin grafts. However, donor-site tissue availability is a major obstacle to the successful replacement of large skin defects. The tissue expansion technique has been applied to obtain new skin tissue to repair large defects in clinical practice. Very recently, our team developed an in vitro skin bioreactor for expanding autologous skin grafts. In this study, we confirmed that expanded skin maintains its viability, as well as its cell proliferation activity while maintaining expanded surface area and porosity. Therefore, application of in vitro skin expansion bioreactor may be an alternative way for effective expansion of full-thickness skin.

Student Oral

좌장 : 유선국 (연세대학교)

Medical Imaging

Neural Engineering

Tissue Engineering and Biomaterials

Biomedical Optics

Medical Nano and Microtechnology

Orthopedic and Rehabilitation Engineering

Biomedical Engineering Education and Career

Student Oral

Medical Imaging

SO-01 MREIT 시스템을 이용한 마이크로미터 수준에서의 생체 도전율 영상

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Recent experimental MREIT studies demonstrated conductivity image reconstructions of in vivo animal and human subjects with a few millimeter pixel size. Such a resolution could be sufficient to distinguish different human tissues for certain applications. In order to visualize a conductivity distribution within a tissue or a small animal, it is necessary to develop a high-resolution MREIT technique. The experimental results using a 3 T MRI scanner with a multi-echo ICNE pulse sequence and multi-channel RF receiver coil demonstrate that we can reconstructed conductivity images with a pixel size as small as 400 μm.

Neural Engineering

SO-02 멀티채널 미세전극 어레이를 이용한 쥐 수염 신경신호 기록

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Whisker-barrel system is a rat's important sensory system for direction judgement and avoiding barricade. Studying whisker-barrel system of rats allows us to control the animals' behavior and analyze biological neural networks in vivo. In this study, multi-channel microelectrode arrays were fabricated using tungsten microwires and the neural spikes were recorded from whisker-barrel somatosensory cortex of rats. This study can be applied to basic neuroscience and brain-computer interface studies for controlling animals' behavior.

Tissue Engineering and Biomaterials

SO-03 히알루론산 하이드로겔 필러의 제조 및 평가

손시원, 전철병, 최지은, 이득용
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Hyaluronic acid (HA) dermal fillers are becoming the material of choice for use in cosmetic soft tissue and dermal correction. The 1,4-butanediol diglycidyl ether(BDDE) crosslinked hyaluronic acid hydrogels (HAHs) are prepared and characterized to improve the longevity of HA because BDDE are used in the majority of the market-leading HAHs due to its stability, biodegradability, safety, and good tissue integration. Morphology, amount of residual BDDE, swelling rate, and storage modulus of HAHs are examined by using scanning electron microscope, gas chromatography, and rheometer. Experimental results reveals that the as-prepared HAHs are suitable for the use of dermal filler due to the absence of residual BDDE (〈0.2ppm) and the tailored viscoelastic properties.

Biomedical Optics

SO-04 유리 캡 보호 산광형 광섬유를 이용한 하지 정맥류 치료의 온도 분포 연구

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Laser treatment of varicose vein with optical fibers is called as endovenous laser ablation (also known as EVLA). In order to prevent thermal damage during treatment and to decrease post-operational complication, a diffusing fiber tip integrated with a glass cap was developed, and the treatment temperature between commercial and newly-designed fibers was quantitatively compared. The aim of the study was to validate the feasibility of the diffusing fiber as a novel tool to treat blood vessel disorders with minimal thermal damage by evaluating temperature distribution in a tissue phantom. A 532 nm wavelength was used to generate indirect thermal effects to the peripheral tissues during laser irradiation. For temperature monitoring, a raw potato perfused with chicken blood were used as a tissue phantom due to high contents of water. The results demonstrated that the thermal profile developed by the diffusing fiber was associated with lower and uniform temperature profile (about 50 degree) while the one by flat fiber tip displayed instantaneous temperature increase (up to 75 degree). The temperature gradient to reach the highest temperature was measured to be 7.8 and $3^{o}C/sec$, respectively, which indicates 160 % faster temperature increase with the flat fiber, compared to the diffusing one. In the current study, the glass-capped diffusing fiber could provide safe treatment for varicose vein along with minimal pain and burn skin.

Medical Nano and Microtechnology

SO-05 마이크로 유체 시스템에서 hydraulic jump phenomenon을 이용한 혈액 내 백혈구 및 적혈구 분리

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This paper suggest an improved hydrodynamic method for separating blood cells by hydraulic jump phenomenon on microfluidic device. In biomedical diagnostic, the number of blood cells is important factor for diagnosing disease and analyzing health states. Generally, method for complete blood cell count (CBC) is centrifugation or fluorescent activated cell sorter (FACS). However, these methods need additional fluorescent antibody tagging and lysis with agent that could be influence to viability and have disadvantage to point of care(POC) in MEMS. So, this technique will enable to sorting leukocyte, erythrocyte by size with high cell viability using PDMS in continuous conditions on a chip.

Orthopedic and Rehabilitation Engineering

SO-06 폐 절제술 환자를 위한 모바일 호흡훈련 시스템 개발 및 임상적용에 대한 예비연구

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The prevention of pulmonary complication after lung resection is very important. Recently, several breathing training programs have been introduced but it is not enough to lead interest of patients to the rehabilitation and to provide methodical and elaborate exercises with real time feedback. Therefore, in this paper, we aimed to suggest and develop mobile based respiration training program to help patients to recover from pulmonary function and prevent any postoperative complications. The system of the mobile based rehabilitation program is composed of a breathing detection module and a mobile device with game content. A clinical experiment was conducted with one patient and it showed positive results in the respiration rehabilitation. This system

could draw patient's interest in breathing training and attracts voluntary participation of patients. With the program, individual who need respiration training could be helped by providing simple paradigm which can be used in their home.

Biomedical Engineering Education and Career

SO-07 KCNJ2 E299V 유전자 돌연변이가 회귀성 심실부정맥에 미치는 영향 예측을 위한 수치적 연구

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E299V mutation causing a shot QT syndrome to form APD reduction and a genetic arrhythmia. Ventricular model was simulated for the epicardium cell, endocardium cell, myocardium cell. 3D simulation was used to generate the S2 method for generating a reentry. Computer simulation using this model was used to predict APD, Wavelength, reentry Depending on the combination of form E299V. The control reentry wave was maintained up to the state 7540 ms. But heterogeneous and homogeneous reentry wave was maintained up to the state 10000ms and break-up does not generate. The E299V mutation occurring cause of the decline of APD, wavelength and created reentry.

Student Poster

Student Poster

SP-01 신경조직의 기능 영상화를 위한 MEA 기반 Microscopic EIT 시스템의 성능 분석

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We developed the microscopic electrical impedance tomography (Micro-EIT) system based on a microelectrode array (MEA) for imaging functionality of neural tissue. The neural ion conduction and related bioelectromagnetic parameters are instantaneous and direct biomarkers of brain neural activities. The micro-EIT system consists of 14 voltmeters for 112 voltage sensing electrodes and a balanced current source for two directional current injection. We calibrated the output impedance and DC offset of current source module using dedicated calibrator logics. In this paper, we described the results of performance evaluation and phantom experiments using micro-EIT system.

SP-02 포세린 비니어와 지르코니아 복합체에 대한 복합 레진의 전단접착강도

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Recently, the clinical indication of fixed dental prostheses made of a zirconia framework veneered with a glassy matrix ceramic has increased due to the improved CAD/CAM technology in dentistry. However, chipping of veneering ceramic at varying rates regardless of the type of veneering ceramic used is still one of the common problems during the clinical services of zirconia-based restorations. The findings of this in vitro study suggest that proper selections of surface conditioning methods and primers is critical for enhanced resin bonding to porcelain/zirconia complex.

SP-03 신생아 수면환경을 위한 모니터링 시스템 개발

공호준, 방상광, 박대광, 권윤아, 웨이천, 박희준
계명대학교 의과대학 의용공학과

Temperature and humidity affect on the environment of the sleeping newborn. Due to environment changing, the newborn could not sleep well. In this paper, developing a smart environment monitoring system for sleeping newborn is presented. The proposed system is divided into sensor part and wireless communication part. The temperature and humidity are measured by sensor part, and the data is delivered to smartphone by Bluetooth in real time. For testing the system performance, the proposed system was compared with a commercial environment measuring device in a closed environment for 1 hour. Through the experimental results, the proposed system is provided it is able to measure the temperature and humidity more accurately than the commercial device.

SP-04 산광형 광섬유를 이용한 인체 지방제거의 균일한 온도 증가 연구

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The aim of the current study was to validate an optically diffusing fiber for laser lipolysis. To overcome the complications of laser treatment with conventional flat fibers, the diffusing fiber was developed as an alternative tool for fat liquefaction. The diffuser emitted an almost uniform energy in a cylindrical from along the diffuser tip with a low intensity. During treatment, peak temperature and liquefaction threshold were measured for quantification. The

results showed that the liquefaction threshold decreased with laser power. Treatment results demonstrated that the diffusing optical fiber covered a wider liquefied area in spite of application of lower power intensity. Optical diffusing fibers can be a feasible tool for laser lipolysis in term of safe and efficiency treatment.

SP-05 미세 유체칩 상의 간세포와 간 성상세포의 3차원 구상체 배양을 기반으로 하는 알코올성 질병 모델

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Liver is an organ fulfilling much metabolism such as detoxification. So, new drugs and therapies developed for liver need to be tested. Then, we use in vitro models having similar aspect to in vivo organ. Existing 2D in vitro models revealing their limitations, 3D in vitro models are proposed. Among the 3D in vitro models, we choose 3D spheroid model. Spheroids can necrotize because center cells of spheroids are difficult to intake nutrition and oxygen. To overcome this problem, we use a microfluidic chip which can give micro-flow to spheroids organized two types of cells, Hepatocyte and Hepatic Stellate Cell.

SP-06 척추측만증 교정을 위한 진동 자극 시스템 개발

진형원, 최우혁, 김동현, 김한성, 신태민
연세대학교 보건과학대학 의공학부

In this study 18-channel attachable vibration stimulus sensor is developed to support diverse positions of vibration stimulus for scoliosis correction. Also, the system can control the frequency of vibration from 0Hz to 83Hz to support variable vibration stimulus. This can be used for researches to decide the proper position and frequency of vibration stimulus for the treatment of scoliosis.

SP-07 3D 프린터를 이용한 환자 맞춤형 MRI-RF Head coil 제작

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울산대학교 전기공학부 의공학전공

In MRI system, radio frequency (RF) coil transmits and receives MR signal. The coil has the static size that it makes the gap between the human head and the RF coil that causes signal loss. In this article, we designed RF coil that has the teeth to adjust the position of the resonators. B1+field on the two different simulation environment, conventional RF coil and adjusted RF coil shape that each resonator placed to the head closer, showed that, shortening the gap improves the strength of B1+field applied on the head. To make this proposed RF coil, 3D printer was used.

SP-08 휴대용 & 손잡이형 근적외선 방사 스캐너

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Near-infrared (NIR) optical imaging modality is one of the widely used medical imaging techniques. However, conventional NIR imaging systems are bulky and expensive, thereby limiting their accelerated clinical translation. Herein a new compact, cost-effective, and wide-field NIR scanner has been developed towards contact as well as no-contact based real-time imaging. Preliminary phantom and in-vivo studies demonstrated the possibility of detecting tumor images and the feasibility of real-time monitoring of blood flow changes. Currently, extensive in-vivo studies are carried out using the ultra-portable NIR scanner in order to assess the potential of the imager towards breast imaging and muscle

Student Poster

oxygenation.

SP-09 폐 환기 모니터링을 위한 임피던스 단층 촬영 시스템용 섬유전극기반 환자 인터페이스 설계

김광우[1], 위헌[2], 안유진[3], 오동인[1], 김갑진[3], 우응제[1]

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Electrical conductivity imaging can monitor lung ventilation continuously. Conventionally, clinical studies for electrical impedance tomography require a cumbersome procedure to attach many individual electrodes equidistantly. Good electrode contact is essential to acquire high-quality signals. And position error for each electrode deteriorates the quality of reconstructed image. In this study, we developed an electrode interface for monitoring of lung ventilation. The belt includes 16 embossed conductive polymer electrodes and electronic circuits. We describe the design and performance of the patient interface.

SP-10 3차원 심실의 전기생리학적 모델을 이용한 KCNJ2 D172N 돌연변이가 회귀성 심실빈맥에 미치는 영향에 대한 분석

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KCNJ2 gene mutation arises at gain-of-function of IK1 channel that is associated with short QT syndrome 3 (SQT3). We have simulated Ik1 current changes in Kir2.1 D172N mutation. Two cases were considered. One considered wild type (WT), heterozygous (WT-D172N) and homozygous (D172N), the other considered epithelial, mid myocardium, endothelial cell types. The WT, WT_D172N, D172N was short APD by order. The short APD is shown long period of reentry or high incidence of break up. IK1 Increasing IK1 according to KCNJ2 gene mutation caused SQT3 and shorten APD in ventricular can increase the fibrillation was lead to sudden heart attack.

SP-11 MoS$_2$-은 박막 기반 고감도 표면 플라즈몬 공명 바이오센서 연구

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We propose a new configuration of a surface plasmon resonance (SPR) biosensor using single or multiple MoS$_2$ layers on a silver substrate for sensitive biomolecular detection. Silver has been frequently used as a SPR substrate due to its deep and narrow SPR band, while silver can suffer from poor chemical stability. MoS$_2$ is a two-dimensional material that has a high optical absorption efficiency in monolayer structure. In addition, it could prevent from oxidation of silver because of hydrophobic and impermeable properties. Taking advantages of MoS$_2$ and silver films, we numerically demonstrate that SPR imaging biosensors with a MoS$_2$-silver substrate can provide greater sensitivity than that of a conventional SPR system.

SP-12 무세포층 내 비구형 입자의 거동에 관한 연구

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Generally, spherical particle in the linear shear flow follows the stream line, but non-spherical particles can drift across the streamline in a linear laminar flow through hydrodynamic and inertial forces on the particle. To achieve effective drug delivery system of intravascularly injected particle, particle

should drift to the wall. In this research, the mathematical prediction for nonspherical, prismatic particle dynamics in the linear shear flow is performed. The drift motion of discoidal and cylindrical particle and triangular prism, rectangular prism and hexagonal prism is analyzed with different flow conditions. The effect of a particle non-sphericity is shown.

SP-13 스마트 와치를 이용한 사격 자세 피드백 시스템 개발

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We developed shooting feedback system using a smart watch and a smart phone. This system can measure user's postural stability and give feedback. For measuring postural stability, we developed and evaluated the algorithm based on accelerometer equipped in smart watch. As a result of algorithm evaluation, the postural stability of worst shot that is calculated by algorithm is less than the postural stability of best shot.

SP-14 인터넷 중독 청소년에서의 성별의 차이: MRI를 사용한 피질골 두께 비교

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김동윤[1], 한봉수[2], 서형석[3]
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Internet addiction is recently becoming a serious mental health issue. However, neurobiological mechanism of internet addiction has not fully expressed. Recent studies suggested internet addiction is associated with brain structure abnormalities. In this study, we used T1-weighted imaging to investigate the effects of internet addiction on the cortical thickness in adolescents. We also analyzed whether there are any different patterns by gender. Using a FreeSurfer, we found internet addiction affects cortical thickness and there are differences between male and female. Our finding suggested that female adolescents with internet addiction have thinner cortical thickness than male.

SP-15 손목 편마비 환자를 위한 FES와 모션센서를 결합한 모바일 재활 시스템 개발

황승현, 구정훈
계명대학교 의과대학 의용공학과

Wrist hemiplegic by stroking is a factor that makes it difficult for the patients to activate daily life. To treat the wrist hemiplegia, there is a method , using the FES(Functional Electrical Simulation) And, There is a research showing that combined voluntary exercise with the FES treatment were effective in wrist extensor muscle. In this paper, we developed mobile system combined a FES wtih a motion sensor to derive the voluntary movement. Also the game was designed in which a patient can play the fishing game with wrist extensor motion.

SP-16 3D 모형 기반 심혈관계 질환 및 부정맥 수술 시뮬레이터 개발

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의료 시뮬레이션을 통한 교육은 환자의 안전을 보장하고 학습 효과를 높일 수 있음으로 의료 환경에 도입되었다. 심장질환치료시술인 카테터 절제술은 숙련된 기술이 요구된다. 따라서 의료 사고의 위험을 줄이기 위해 훈련이 필수적이다. 본 논문에서는 카테터 위치에 따라 CT 이미지 시뮬레이터, 실시간 X-ray 영상을 위한 C-arm X-ray 시뮬레이터, 부정맥 신전도 변화를 관찰 가능한 시뮬레이터 기능을 포함한 심혈관 질환 및 부정맥 수술 시뮬레이터 시스템을 개발하였다.

Student Poster

SP-17 대동맥 풍선펌프의 박동위상이 심실부하 및 관상순환에 미치는 영향에 대한 수치적 분석

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To quantify the reduction in workload during intra-aortic balloon pump (IABP) therapy, indirect parameters are used, such as the mean arterial pressure during diastole, product of heart rate and peak systolic pressure, and pressure volume area. We incorporated an IABP function into a previously developed electromechanical model of the ventricle with a lumped model of the circulatory system. To measure the effect of ventricular unloading according to IABP phase, we conducted a simulation study and measured cardiac responses. These results show that the effect of ventricular unloading is different by IABP phase. IABP therapy causes bad effect in specific phases.

SP-18 벨트형 압력센서 모듈 제작 및 측정 위치에 따른 호흡 파형 비교

박수지, 최화진, 신항식
전남대학교 의공학과

The aim of this research is to develop belt-type respiration sensor and to evaluate the respiration waveform according to the measuring site. Belt-type sensor was fabricated using pressure sensor, FSR-408 and polyester cover, and respiration was recorded at three representative measuring location; head, chest and abdomen. Result shows that the developed sensor could measure the respiration and respiration waveform has the highest correlation value when it located under the chest.

SP-19 0.18 μm CMOS 공정을 이용한 뉴런 회로 모델링

조예빈, 이수현, 정예찬, 이자경, 송한정
인제대학교 나노융합공학부

Integrated circuit of a firing neuron for modeling of the biological nenron was designed using a 0.18 μm standard CMOS technology. Proposed firing silicon neuron model consist of input stage with summing function and firing block. Firing block consists of an amplifier, capacitors and pass transistors with a switch function. Also, synapse circuit was designed with a transconductor and current mirror. SPICE simulation results show that neuron pulse is generated above threshold current of 3 nA.

SP-20 벨트형 압력센서 모듈 제작 및 측정 위치에 따른 호흡 파형 비교

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The aim of this research is to develop belt-type respiration sensor and to evaluate the respiration waveform according to the measuring site. Belt-type sensor was fabricated using pressure sensor, FSR-408 and polyester cover, and respiration was recorded at three representative measuring location; head, chest and abdomen. Result shows that the developed sensor could measure the respiration and respiration waveform has the highest correlation value when it located under the chest.

SP-21 MSP430을 이용한 전완근 EMG 획득 시스템 개발

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Electromyogram is widely used to understand human motion and Electromyogram is widely used as control signal in not only clinical and medical but also industrial and military purposes. Our purpose is making system to detect Electromyogram and control something. The system will be easy-to-carry, small, portable and low power system.

SP-22 신생아 수면유도를 위한 화이트 노이즈 발생 시스템 개발 기초연구

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Due to unstable sleeping habits, the infants are susceptible to many diseases. In order to solve this problem, using white noise to induce infants to sleep has presented in many researches, and some smartphone applications and devices have been manufactured using this method. However, there are many problems have been reported by many studies, such as electromagnetic, convenience and price. In this paper, white noise generator system for infants sleep induction is presented. The proposed system is manufactured by based ARM processor, the white noise is processed by processor and the signal is generated by DAC in development board. For testing the performance of the proposed system, a commercial device is chosen to do a comparison test. As the experimental result, the proposed system is proved that is able to generate white noise exactly.