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## 학회장 인사말

### 대한의용생체공학회 춘계학술대회를 맞이하면서



안녕하십니까?

올해 창립 32주년을 맞은 대한의용생체공학회가 2011년 춘계학술대회를 5월 13일부터 14일까지 대구의 계명대학교에서 개최하게 되었습니다.

이번 춘계학술대회에는 “의료영상 기술의 미래: Multi-Scale Bioimaging Technology”라는 주제로 강의와 토론의 장을 마련하였습니다. 특히 기조 강연자인 대한민국 의료기기 벤처 산업의 개척자 KAIST이민화 교수께서 “한국 의료산업의 새로운 패러다임”을 통찰력 있게 제시하실 것으로 기대합니다. 또한 다양한 주제의 발표 논문들을 토론하는 기회도 마련되어 있습니다.

의학의 역사를 돌이켜 보면, 수많은 의학자 그리고 의공학자들이 “안 보이는 것을 보려는” 노력을 기울인 결과가 현미경, 심전도, 방사선학, 핵의학, 뇌영상학 등으로 이어지는 의료영상 기술의 과거와 현재를 열어 왔다고 생각합니다. 이제 의료영상학의 현재를 더욱 발전시켜 빛나는 미래를 개척하려면 창의적인 사고와 의학, 공학간의 협력이 필수라고 판단합니다.

의료기기 산업의 새로운 중심으로 떠오르고 있는 대구의 역사 깊은 계명대학교에서 우리 모두의 마음과 뇌를 열어 의용생체공학의 미래를 논의할 수 있게 되었음을 매우 기쁘게 생각합니다. 학회 학술위원회의 열정과 전문성을 믿기에 춘계학술대회가 참여하시는 모든 분들에게 아주 유익한 기회가 될 것임을 약속드릴 수 있습니다. 기대에 찬 마음으로 초청합니다.

감사합니다.

2011년 3월

대한의용생체공학회 회장 정도연 올림

## 조직위원장 인사말

### 2011년도 춘계학술대회를 맞이하여



2011년도 대한의용생체공학회 춘계학술대회를 계명대학교 성서캠퍼스에서 개최하게 된 것을 진심으로 기쁘게 생각합니다.

의공학 기술은 다양한 학문과 기술이 결합되어 있으며, 근래에 와서 새로운 산업분야를 창출하는 데 큰 역할을 하고 있습니다. 여러 연구자의 지속적인 노력으로 신기술 개발을 선도하고 의공학 강국으로 나아가고 있는 이때에 대한의용생체공학회 춘계학술대회가 반세기를 이어온 아름다운 계명대학교, 특히 의과대학에서 개최되는 것을 더욱 기쁘게 생각합니다.

2011년도 춘계학술대회를 통해 회원 여러분의 성과와 발전을 기쁘게 나누시고 유용한 정보를 많이 얻어 가시기 바랍니다. 알찬 학술대회가 될 수 있도록 많이 참석하여 주시기 바라며, 우리 조직위원회는 많은 분들이 아름다운 캠퍼스에서 마음껏 학문적 성과를 거두실 수 있도록 최선을 다하겠습니다.

감사합니다.

2011년 3월 2일

대한의용생체공학회 제43회 춘계학술대회 조직위원장 **김윤년** 올림

# 대한의용생체공학회 제18대 임원

직책	성명	소속	직책	성명	소속
회장	정도연	서울대	편집이사	이상훈	고려대
수석부회장	조진호	경북대		이재성	서울대
부회장	선 경	고려대		안원식	서울대
	손원길	메디슨	정보이사	노정훈	부산대
감사	차은중	충북대		김법민	고려대
	허 웅	명지대		김태성	경희대
총무이사	최진욱	서울대	국제협력이사	김희찬	서울대
	지영준	울산대		유규하	식약청
기획이사	최귀원	KIST		김용주	벡톤 Dickinson코리아(주)
	김인영	한양대	산학협력이사	김명남	경북대
재무이사	이원진	서울대		이봉수	건국대
	정선근	서울대		신흥범	코모키수면클리닉
교육이사	김동욱	전북대	특임이사	김 린	고려대
	김주명	광양보건대		홍성화	삼성병원
학술이사	정병조	연세대		김윤년	계명 의대
	신정욱	인제대			
	남윤기	KAIST			

## 정보위원회

직책	성명	소속	직책	성명	소속
정보이사	노정훈	부산대	위원	공현중	서울대
정보이사	안원식	서울대	위원	신범주	부산대
위원	서광석	서울대	위원	정동근	동아대
위원	최성욱	강원대			

## 학술위원회

직책	성명	소속	직책	성명	소속
학술이사	신정욱	인제대	위원	이수홍	차의과학대
학술이사	남윤기	KAIST	위원	임도형	한국생산연구원
위원	최영빈	서울대	위원	서종모	서울대
위원	변경민	경희대	위원	정 용	KAIST
위원	양 성	GIST	위원	박재영	고려대
위원	전누리	서울대	위원	심은보	강원대
위원	황도식	연세대	위원	최성욱	강원대
위원	임창환	연세대			

교육위원회

직책	성명	소속	직책	성명	소속
교육이사	김동욱	전북대	위원	심은보	강원대
교육이사	김주명	광양보건대학	위원	오대호	한림성심대학
위원	정병조	연세대	위원	윤종인	대구가톨릭대
위원	권기진	영남이공대학	위원	이기영	관동대
위원	김법민	고려대	위원	이주원	안동과학대학
위원	김선정	한양대	위원	이동훈	동명대
위원	김성민	건국대	위원	이석재	서남대
위원	김영곤	인제대	위원	이수열	경희대
위원	김정래	울지대	위원	임용규	상지대
위원	김희영	동주대학	위원	임재근	극동정보대
위원	나승권	폴리텍대학(원주)	위원	천민우	동신대
위원	박기영	전주비전대학	위원	최병철	춘해대학
위원	박해암	남부대	위원	최승한	대구한의대
위원	박현진	가천의과대학	위원	태기식	건양대
위원	서광석	서울대			

편집위원회

직책	성명	소속	직책	성명	소속
편집이사	이상훈	고려대	위원	이계한	명지대
편집이사	이재성	서울대	위원	한동근	한국과학기술연구원
위원	이수열	경희대	위원	송병섭	대구대
위원	이종민	한양대	위원	김한성	연세대
위원	권성훈	서울대	위원	임창환	연세대
위원	임도형	한국생산기술연구원	위원	신정욱	인제대
위원	유선국	연세대	위원	김동욱	전북대
위원	정동근	동아대	위원	이성재	인제대
위원	엄광문	건국대	위원	이우철	울지대
위원	남윤기	KAIST			

## 프로그램위원회

## • Biomedical Optics

변경민\_경희대학교

최영빈\_서울대학교

## • Biomedical Robotics

임도형\_한국생산기술연구원

박재영\_서울대학교

## • Cardiovascular Engineering

최성욱\_강원대학교

정용\_KAIST

## • Medical and Bioinformatics

최진욱\_서울대학교

남윤기\_KAIST

## • Medical Imaging

황도식\_연세대학교

임창환\_연세대학교

## • Medical Nano and Microtechnology

양성\_GIST

전누리\_서울대학교

## • Neural Engineering

남윤기\_KAIST

임창환\_연세대학교

## • Orthopedic and Rehabilitation Engineering

신정욱\_인제대학교

임도형\_한국생산기술연구원

## • Respiratory Engineering

정용\_KAIST

박재영\_서울대학교

## • Systems Biology, Physiological modeling

심은보\_강원대학교

최성욱\_강원대학교

## • Tissue Engineering and Biomaterials

이수홍\_CHA의과대학교

최영빈\_서울대학교

## • U-Health, eHealth Technology

서종모\_서울대학교

양성\_GIST

## • Biomedical Engineering Education and Career

지영준\_울산대학교

신정욱\_인제대학교

## 조직위원회

직책	성명	직책	성명
위원장	김윤년	위원	구정훈
위원	박희준	위원	

# 춘계학술대회 프로그램 일정

- 주 최: 대한의용생체공학회
- 주 관: 대한의용생체공학회, 계명대학교
- 일 정: 2011년 5월 13일(금)~14일(토)
- 장 소: 계명대학교 의과대학 대강당

날짜	시간	내용				
5.13	10:00 ~ 12:00	튜토리얼: 그래픽기반 시스템을 활용하는 생체신호계측분석 기술(계명대-NI 의료특화교육센터)				
	13:00 ~ 13:30	개회식				
	13:30 ~ 14:20	기조강연 - 의료산업 세계화를 위한 디지털병원 전략(이민화 박사)				
	14:30 ~ 16:30	심포지움 1	심포지움 2			
	16:30 ~ 17:50	포스터 1				
5.14	18:00 ~ 18:30	오케스트라 공연				
	18:30 ~ 20:30	만찬				
	09:00 ~ 10:30	포스터 2				
	10:30 ~ 12:30	일반연제 1	일반연제 2	일반연제 3	일반연제 4	일반연제 5
	12:30 ~ 13:30	점심/파이프 오르간 연주				
	13:30 ~ 15:00	포스터 3	신진연구자 - 초청강연	의료기기 - 특별강연		
	15:00 ~ 15:30	폐회식				

## 5월 13일 금요일

10:00 ~ 12:00 PM	실습강좌: 그래픽기반 시스템을 활용하는 생체신호계측분석 기술 진행: 박희준 교수 (계명대학교) / 김광현 과장 (한국내쇼날인스트루먼트)
10:00 AM	“IT 융복합 의료/생명과학 기술 사례 (영상진단기기, 의료로봇시스템, 치료기기 분야)”
10:30 AM	“LabVIEW를 활용한 데이터 수집 실습” * 아날로그 신호 측정과 신호처리/분석 함수
11:00 AM	“Vernier 센서를 이용한 생체신호 계측/분석” * PMS(Patient Monitoring System), ECG 신호 수집/분석 (Wavelet)
11:00 ~ 1:00 PM	등록
1:00 ~ 1:30 PM	개회식 (대강당)
1:30 ~ 2:20 PM	기조 강연 (대강당) (좌장: 남윤기 교수)
1:30 PM	“한국의료산업의 새로운 패러다임” 이민화 박사 (메디슨 창업자 / 카이스트 교수 / 벤처기업협회 명예회장 / 디지털 병원 수출조합 이사장)
2:30 ~ 4:30 PM	심포지움: Multi-Scale Bioimaging Technology
2:30 ~ 4:30 PM	심포지움 1. Biological Imaging (M212) (좌장: 남윤기 교수)
2:30 PM	“나노플라스모닉스를 이용한 생체분자의 측정 및 영상화”, 김동현 교수 (연세대학교)
3:00 PM	“Single-molecule imaging of membrane biology”, 윤태영 교수 (KAIST)
3:30 PM	“Zooming in cancer: what does imaging do for tumor biology?”, 정의현 교수 (GIST)
4:00 PM	“Micro/macro-scale optical imaging for medicine”, 김범민 교수 (고려대학교)
2:30 ~ 4:30 PM	심포지움 2. Medical Imaging (M214) (좌장: 김태성 교수)
2:30 PM	“MR 기반 세포영상”, 문치웅 교수 (인제대학교)
3:00 PM	“Recent technological advances in diagnostic and therapeutic ultrasound” 유양모 교수 (서강대학교)
3:30 PM	“Advances in PET/MRI researches”, 이재성 교수 (서울대학교)
4:00 PM	“Why high field MRI?: can we use it?”, 유형석 교수 (울산대학교)
4:30 ~ 5:50 PM	포스터 발표 1 (동편 1층/2층 복도)
6:00 ~ 6:30 PM	오케스트라 공연 (대강당)
6:30 ~ 8:30 PM	만찬 (세인트웨스턴호텔 6층 컨벤션홀)



## 5월 14일 토요일

09:00 ~ 10:30 AM	포스터 발표 2 (동편 1층/2층 복도)
10:30 ~ 12:10 PM	일반연제 1. 스마트 유헬스케어 (M214) (좌장: 이상우 교수)
10:30 AM	“박출량과 박동성 조절이 가능한 맥동 펌프의 개발”, 윤수영 (경북대학교)
10:50 AM	“심박조율 기능을 갖춘 박동형 좌심실보조장치의 개발”, 김유석 (강원대학교)
11:10 AM	“로봇 수술을 위한 영상에서의 출혈 검출 및 인지”, 류지원 (서울대학교)
11:30 AM	“모바일 기반의 만성창상(욕창) 원격상담 기술 개발 및 유용성 평가”, 허찬영 교수 (서울대학교 분당병원)
11:50 AM	“일상생활간 지속적 뇌 모니터링을 위한 순간 전류구동 16채널 fNIRS 모듈 설계 및 성능 평가” 이종민 (서울대학교)
10:30 ~ 12:10 PM	일반연제 2. 바이오 이미징 그리고 영상 (M213) (좌장: 변경민 교수)
10:30 AM	“이광자 현미경과 빛간섭 단층 촬영의 결합 시스템을 이용한 마우스 소장 이미징” 정보수 (포항공과대학)
10:50 AM	“단일벽 탄소 나노튜브 조영제를 이용한 광음향 단층 촬영 기술”, 구자성 (부경대학교)
11:10 AM	“탐플릿 표면 모델 기반 3차원 상부 경추 형태 복원 기법”, 김재일 (KAIST)
11:30 AM	“영상분할 기반 전신 PET/MR 감쇠보정의 표준섭취계수 평가”, 김중현 (서울대학교)
11:50 AM	“뇌에서의 [11C]sertraline 동적 PET스캔 적정시간 선정 및 준정량화 방법 유용성평가” 김지후 (서울대학교)
10:30 ~ 12:10 PM	일반연제 3. 신경공학 (M212) (좌장: 임창환 교수)
10:30 AM	“큰 변형이 가능한 PDMS 기반의 신경 자극용 평면형 전극”, 추남선 (GIST)
10:50 AM	“청각 자극의 선택적 집중을 이용한 실시간 뇌-컴퓨터 인터페이스 개발”, 김도원 (연세대학교)
11:10 AM	“표면 미세도형의 기하학적 특징이 축색돌기 성장에 미치는 영향”, 장민지 (KAIST)
11:30 AM	“완전이식형 인공와우용 전류 자극기 설계”, 김진호 (서울대학교)
11:50 AM	“Spike train decoding을 이용한 다채널 동시 전기자극에 대한 변성망막의 시공간적 정보 인코딩 특 성 관찰”, 류상백 (연세대학교)
10:30 ~ 12:10 PM	일반연제 4. 마이크로 기술, 나노재료, 그리고 조직공학 (M112) (좌장: 양성 교수)
10:30 AM	“의료용 장갑과 콘돔에서의 시험평가방법 확립에 관한 연구”, 최승호 (한국화학융합시험연구원)
10:50 AM	“크기조절이 가능한 배상체 생산을 위한 매니스커스를 이용한 오목한 마이크로 웰 어레이 마이 크로 유체 칩”, 정기석 (고려대학교)
11:10 AM	“유전체 박막을 이용한 표면플라즈몬공명 바이오센서의 감도향상”, 조창희 (경희대학교)
11:30 AM	“마이크로캔틸레버를 이용한 i-motif DNA의 구조변화에 미치는 화학적 환경에 대한 연구” 정수호 (연세대학교)
11:50 AM	“서방형 약물전달을 위한 멀티 채널& well로 구성된 마이크로칩”, 이승호 (서울대학교)
10:30 ~ 12:10 PM	일반연제 5. 생체역학, 재활공학 그리고 의료 로봇 (M111) (좌장: 임도형 박사)
10:30 AM	“초음파 프로브의 압력이 영상 선명도에 미치는 영향”, 김민태 (국립암센터)
10:50 AM	“유착성관절낭염 환자의 바이오피드백 재활 치료를 위한 통증 모멘트 검출”, 이상기 (건국대학교)
11:10 AM	“게임 콘텐츠를 이용한 근전도 기반의 무선 근 재활 시스템 개발”, 이영호 (인제대학교)
11:30 AM	“승마운동형 운동기구를 이용한 운동량 추정에 관한 연구”, 정경렬 (한국생산기술연구원)
11:50 AM	“일차성 퇴행성 관절염 진행으로 인한 골 미세구조 특성 변화 추적 관찰” 이주형 (한국생산기술연구원)
12:10 ~ 1:30 PM	점심 / 파이프 오르간 연주 (아담스채플관)
1:30 ~ 3:00 PM	포스터 발표 3 (동편 1층/2층 복도)
1:30 ~ 2:50 PM	신진연구자 초청강연 (M212) (좌장: 신정욱 교수)
1:30 PM	“A systems approach to engineering cancer nanotechnologies”, 박지호 교수 (KAIST)
1:50 PM	“Lab on a chip technologies for cell, protein and DNA analysis”, 천홍구 교수 (고려대학교)
2:10 PM	“In-vivo optical measurement of activity-dependent fluorescence change in the mouse striatum”, 전상범 교수 (이화여자대학교)
2:30 PM	“Auditory nerve response to electric stimuli”, 우지환 교수 (울산대학교)
1:30 ~ 2:30 PM	의료기기 특별강연 (M213) (좌장: 안원식 교수)
1:30 PM	“의료기기 국제표준과 기준규격 (개발자 입장)”, 이상학 박사 ((주)맥아이씨에스)
2:30 PM	“의료기기 국제표준과 기준규격 (연구자 입장)”, 안원식 교수 (서울대학교)
3:00 ~ 3:30 PM	폐회식 (대강당)

- 학회장소 : 계명대학교 성서캠퍼스 의과대학 대강당



- 계명대학교 성서캠퍼스 내 의과대학 - 강창역 6번 출구에서 도보로 5분 거리

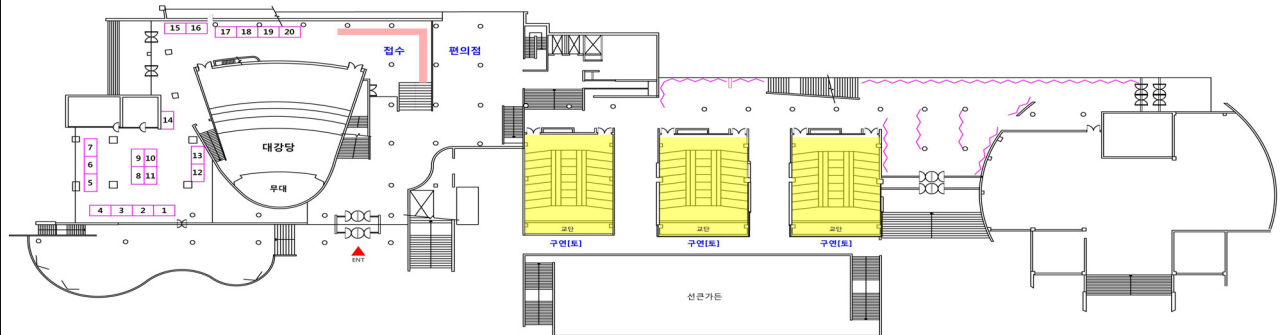
주 소 : 704-701 대구광역시 달서구 달구벌대로 2800 계명대학교 의과대학

전화번호 : (053) 580-3712~5, Fax : (053) 580-3717

출발지	구분		도착지
대구시내	지하철	동대구역[1호선]→(반월당)→계명대역[2호선] 대구역[1호선]→(반월당)→계명대역[2호선]	성서 캠퍼스
	버 스	급행1, 달서2, 달서3, 성서1, 성서1-1, 성서2, 425, 503, 508, 521, 527, 564, 655	
동대구역	지하철	동대구역[1호선]→(반월당)→계명대역[2호선]	
	버 스	521, 805	
대구역	지하철	대구역[1호선]→(반월당)→계명대역[2호선]	
동대구고속 버스터미널	지하철	동대구역[1호선]→(반월당)→계명대역[2호선]	
	버 스	521	
서대구고속 버스터미널	버 스	527	
	지하철	성당못역[1호선]→(반월당)→계명대역[2호선]	
서부정류장	버 스	564, 805	
	버 스	521	
서울 방면	자가용	경부고속도로→서대구진입→광주마산방면(구마고속도로)으로 진입하여 약 3km 주행→성주방면으로 빠져나온 후→성서방면으로 약 2km주행	
부산, 울산, 경주, 포항 방면		경부고속도로 이용→동대구나 북대구로 진입하지 말고 광주·마산방면 (구마고속도로)으로 진입하여 약 3km 주행→성주방면으로 빠져 나온 후→성서방면으로 약 2km 주행	
마산, 광주 방면		구마 또는 88고속도로 이용→성주 방면으로 빠져 나온 후→성서방면으로 약 2km 주행	

제43회 대한의용생체공학회 춘계학술대회

2011.5.13-5.14



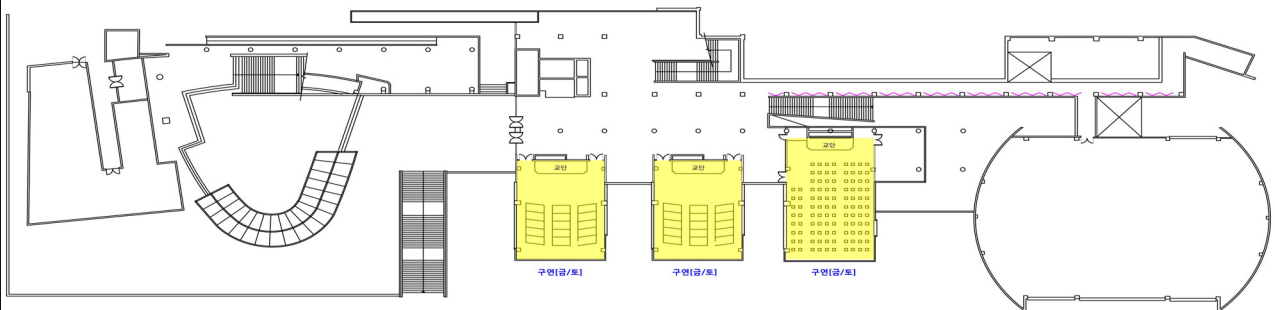
기본부스 2.5m x 1.5m : 20ea

포스터보드 84ea = 96side

대구 계명대학교 성서캠퍼스 의과대학 1층

제43회 대한의용생체공학회 춘계학술대회

2011.5.13-5.14



포스터보드 45ea = 45side

대구 계명대학교 성서캠퍼스 의과대학 2층

※ 참가비 납부방법

2011 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 회원으로써 연회비 납부와 사전등록비를 각각 따로의 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)

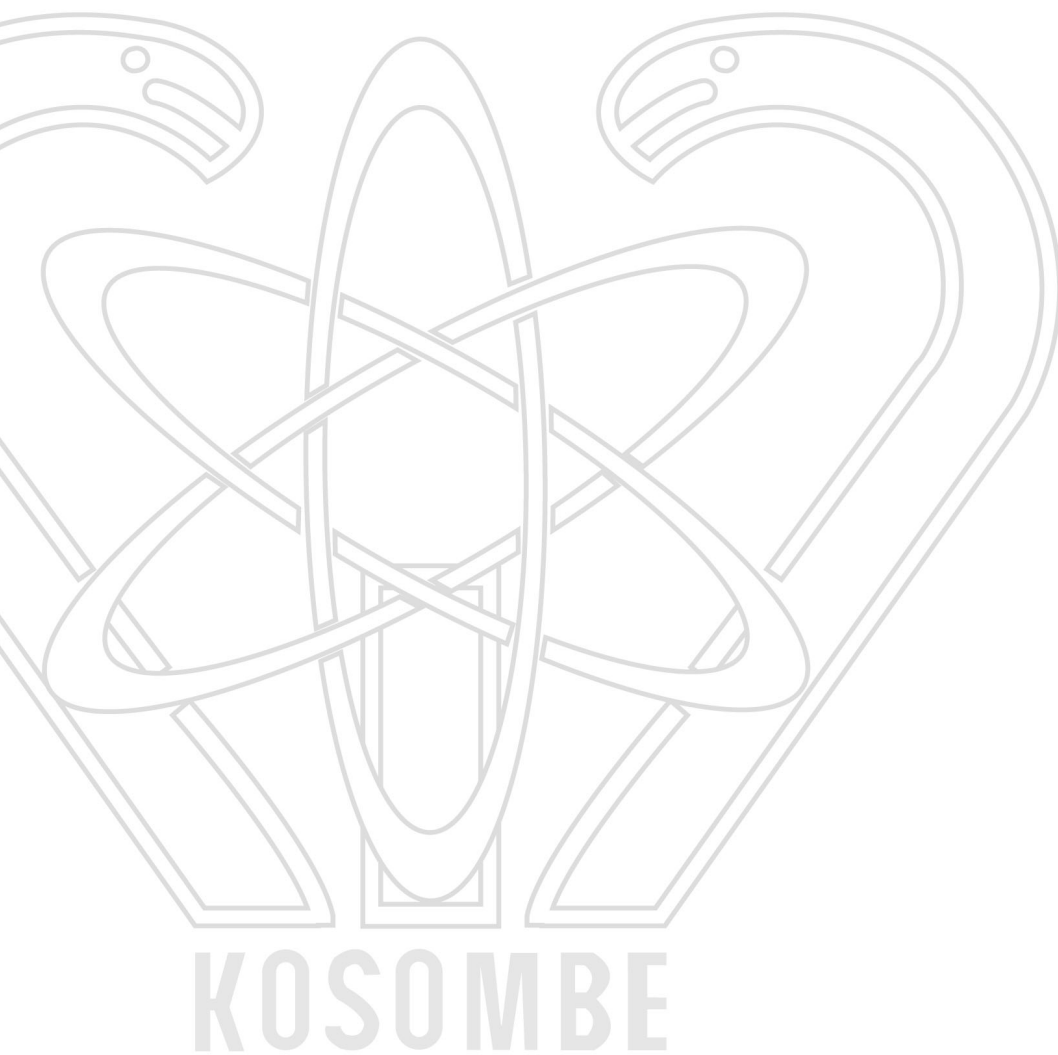


2011년도 제43회 대한의용생체공학회 춘계학술대회

## 기조강연



- **의료산업 세계화를 위한 디지털병원 전략**  
이민화 교수  
KAIST







## 의료산업 세계화를 위한 디지털병원 전략

이름 : 이민화 / 공학박사

직위 : 초빙교수

소속 : 카이스트 (KAIST)

기타 : 벤처기업협회 명예회장, (사)유라시안네트워크 이사장,  
한국디지털병원수출사업협동조합 이사장

전세계적 인구의 노령화와 웰빙 트렌드로 21세기 최대산업은 의료산업으로서, 한국의 의료산업도 복지를 넘어 국제산업의 관점에서 접근이 필수적이다. 한국의료산업은 세계시장에서 상대적으로 원가우위 및 저렴한 의료비용체계, 우수한 의료인력 및 높은 수준의 임상의료기술, 다양하고 특화된 의료기기 제조·공급역량과 세계 선도적 IT융합기술의 강점을 갖고 있다. 그러나, 기존의 개별 의료산업은 국제시장 무대에서 GE, Siemens, Johnson & Johnson 등 거대 다국적 기업 중심으로 진입장벽을 구축하고 있어, 세계시장의 신규 진입이 매우 어려운 것이 현실이다.

본 연자는 이에 대한 한국의료산업의 특화된 대응방안으로 디지털병원 수출전략을 제시한다. 의료산업의 75%는 의료서비스이며, 이러한 의료서비스와 IT의 융합으로 병원자체의 수출전략사업화가 가능하다. 또한, 의료환경의 격변 및 병원의 패러다임의 변화로 의료산업의 성격이 제조기반 산업에서 지식문화융합서비스 산업으로 전환되고 있다. 기존의 고전적 병원의 문제점은 환자접근성 미약, 노동집약적 비능률, 의료의 질 관리부진, 규모의 경쟁력 미약 및 고립적 경영 등 고비용·저효율의 구조로 병원경영의 심각한 문제점을 내포하고 있다. 이러한 문제점을 해결하기 위해 병원의 의료환경은 디지털병원 (Digital Hospital)으로 대표되는 IT의료융합서비스로 급변하고 있으며, 환자접근성 강화, 정보집약적 능률성, 과학적 질 관리의 활성화, 정보 및 기술의 경쟁력, 수직·수평적 네트워크를 확보한 저비용·고효율의 병원운영이 가능한 장점이 있다.

이러한 패러다임의 전환시기에 한국의료산업은 IT기술과 융합된 디지털병원의 패키지 수출로 특화되어, 시장 경쟁력 확보 및 시장선점, 고부가가치 국부창출이 가능한 신성장산업으로 변모하고 있다. 현재, 중동, 동남아, 중앙아시아, 남미 등 자원부국·신흥개발도상국을 중심으로 한 보건의료현대화의 수요 급증으로 하드웨어 (병원건설·의료기기)와 소프트웨어 (의료IT·의료서비스·운영관리·금융)가 결합된 융·복합시장이 급속도로 확대되는 추세에 있다. 본 연자는 이를 위해 GH Project (Global Hospital Project)라고 명명하고, GH-1 (종합병원수출), GH-2 (전문 병·의원 수출), GH-3 (Cross Border Medicine, 의료관광)로 구분하여, 지난 3년전부터 현재까지 범국가적 사업의 일환으로, 정부를 포함하여 학·연·산·관 및 의료계와 함께 유기적이고 체계적인 인프라를 조성해오고 있는 중에 있다. 또한, 이를 뒷받침하기 위해, 정부 차원에서 디지털병원 수출사업을 미래 신성장 국책사업으로 지정하여 적극 육성 중에 있으며, 대상국가에 패키지 방식의 디지털병원의 전략적 수출을 적극 활성화하고 있는 단계에 있다.

이러한 디지털병원의 수출을 기반으로 한 한국의료산업의 해외수출 활성화는 개발도상국에 효율적이고, 경제적인 한국의 의료시스템 정착을 통한 지속적이고 안정적인 시장확보 및 시장선점으로 의료기기산업을 포함하여 한국의료산업의 발전 및 국부창출에 큰 기여를 할 것이다. 또한, 디지털병원수출산업은 의공학이 관련산업 제 분야의 학문과 융합되어, 디지털병원공학이라는 새로운 학문을 태동시키는 시금석이 될 것으로 예상된다.

#### 소 개

1985년 카이스트 (KAIST)에서의 연구결과와 수많은 발표 논문을 바탕으로 한국최초의 벤처기업인 (주)메디슨을 설립, 세계적 의료기기 회사로 성장시켰다. 이 경험을 바탕으로 30여 개의 의료 전문회사 설립을 촉진하여, 한국 총 의료기기 수출의 70%를 기여했다. 1995년 벤처기업협회 설립을 주도, 벤처비전 2005 를 발표하고 벤처기업특별법을 제정, 코스닥 설립, 주식옵션 제 도입, 벤처빌딩, 실험실 창업제도 등 수많은 벤처정책을 입안하여 한국의 벤처대국 입지형성에 기여하였다. 이 경험을 바탕으로 한 경영, 한국벤처산업발전사, 21 세기 벤처대국을 향하여, 초생명 기업 등을 저술하는 한편, 아래한글 살리기 운동을 주도하여, 한국소프트웨어의 자존심을 건지하였다.

기술적으로 디지털 초음파 진단기술, 3차원 초음파 진단기술에 결정적인 논문을 저술하고 관련특허를 취득하였다. 한국이 주도하여 세계 3차원 초음파 학회 설립을 한 바 있다. 그 외에도 의료 통신 분야의 특허 90 여건을 발명하여 새로운 u-healthcare, mobile 혁명의 초석을 만들었다.

포상으로는 금탑산업훈장, 철탑산업훈장, 벤처기업대상, 대통령표창, 중소기업최고경영자상, 한국능률협회 한국경영자상, 한국공학기술상 등이 있다. 98년도 이후 중소기업 특별위원회, 규제개혁위원회, 사법개혁위원회, 한국과학기술원 동창회 회장을 역임했고, 벤처 나눔 활동의 활성화에 기여하였다. 2007년 한국을 일으킨 엔지니어 60 인에 선정되기도 했다. 최근에는 한국의 선진국 진입 전략으로서 유라시안 네트워크 운동을 주창하고 있으며 관련하여 (사)유라시안 네트워크를 설립, 인문연구소의 유라시안 인문학 연구를 지원하고 있다.

한국의 성장 동력으로서 벤처의 새로운 도약을 위한 벤처 2.0 운동을 2008 년부터 제안하여 벤처 소생태계, 공정거래, M&A 거래소 프로젝트를 주도하고 있다. 현재는 선도 벤처를 중심으로 세계적 기업생태계를 만드는 “1조 벤처 프로젝트”를 통하여 벤처의 미래전략을 제시하고 있다.

2009년 카이스트 (KAIST)에서 벤처기업 선구자로 우리나라 벤처산업 육성에 크게 기여한 공헌을 기리고자 ‘이민화 홀’ 명명식을 가졌으며, 카이스트 초빙교수로 임용되어 기술경영대학원과 과학영재교육연구원에서도 차세대 영재기업인 양성을 위한 교육프로그램에 기여하고 있다.

2009년 7월 23일부터 정부가 추진하는 규제 완화 정책의 일환으로 출범한 기업호민관실 (중소기업 옴부즈



만실)의 초대 기업호민관 (차관급)으로 임명되어 중소기업 관련 규제 발굴 및 불합리한 규제 해소를 위해 활동했다.

2011년 2월부터 한국의료산업의 세계화를 위해 한국디지털병원수출조합을 결성, 이사장으로 활동하고 있다.

#### 학력 및 경력

- 1972. 03 ~ 1976. 02    서울대학교 공과대학 전자공학과 학사
- 1976. 03 ~ 1978. 02    한국과학기술원 전기 및 전자공학 석사
- 1978. 03 ~ 1982. 03    대한전선 주식회사
- 1982. 03 ~ 1986. 02    한국과학기술원 (KAIST) 전기 및 전자공학 박사
- 1985. 07 ~ 2001. 10    (주)메디슨 대표이사
- 2006. 07 ~ 2009. 04    한국기술거래소 이사장
- 2008. 10 ~ 현재        (사) 유라시안 네트워크 이사장
- 2009. 06 ~ 현재        카이스트 (KAIST) 초빙교수
- 2009. 07 ~ 2010. 11.    기업호민관실 (중소기업 옴부즈만실) 호민관
- 2011. 02 ~ 현재        한국디지털병원수출사업협동조합 이사장



2011년도 제43회 대한의용생체공학회 춘계학술대회

# SYMPOSIUM

Multi-Scale Bioimaging Technology



- **나노플라스모닉스를 이용한 생체분자의 측정 및 영상화**

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KAIST 물리학과

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서강대학교 전자공학과/바이오융합

- **Advances in PET/MRI Researches**

이재성 교수

서울의대 핵의학교실 및 WCU 뇌인지과학과

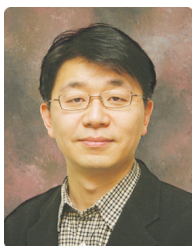
- **Why High Field MRI?: Can We Use It?**

유형석 교수

울산대학교 전기공학부

KOSOMBE





## 나노플라스모닉스를 이용한 생체분자의 측정 및 영상화

이름 : 김동현, PhD

직위 : 부교수

소속 : 연세대학교 전기전자공학부

### Abstract

In this talk, various bioimaging and sensing techniques that are based on excitation and management of structured plasmonic evanescent waves will be presented. An evanescent wave is created under total internal reflection of lightwaves and typically reaches approximately 100 nm from surface. This enables selective investigation of biomolecular interactions that occur near surface at a resolution that would not be achieved in a conventional diffraction-limited system. The enhancement of sensing and imaging characteristics in terms of sensitivity and resolution will be discussed for evanescent wave-based biosensing and imaging systems that employ nanostructure-based bioassays. Results of sensing and imaging various biomolecules, including microtubules and viruses, using periodic or aperiodic random nanostructures will be presented. Furthermore, strategies to best utilize the field localization induced by plasmonic excitation will be suggested. Also, potential applications as well as future directions of these techniques will be explored.

### Bio sketch

Donghyun Kim received the B.S. and M.S. degrees in Electronics Engineering from Seoul National University, Seoul, Korea, in 1993 and 1995, respectively, and the Ph.D. degree in Electrical Engineering from Massachusetts Institute of Technology, Cambridge, MA, in 2001. He was with Corning Inc., Corning, NY, as a Sr. Research Scientist and with Cornell University, Ithaca, NY, as a postdoctoral associate before he joined School of Electrical Engineering, Yonsei University, in 2004. His current research interests lie in biomedical applications of optics and optoelectronics focused on evanescent wave-based techniques including highly sensitive surface plasmon resonance biosensing and imaging systems.



## Single-molecule imaging of membrane biology

이름 : Tae-Young Yoon, PhD

직위 : 부교수

소속 : KAIST 물리학과

기타 : 단분자 시스템스 생물학 창의연구단 단장

### Abstract

Single vesicle fluorescence assay detects the fluorescence signals from surface-immobilized nano-scale vesicles (typically diameter of 50 nm). There are three principal positions for fluorescence labeling: vesicle membranes, luminal contents and membrane proteins, each of which allows for study of different aspects of membrane-related biological processes. During the past five years, we have reported two realizations of these possibilities: Measuring the kinetics of single vesicle-vesicle fusion by labeling vesicle membranes and detecting fusion pore opening in such single vesicle fusion by encapsulating fluorescently-labeled DNA hairpins inside vesicles. In this work, by using fluorescently labeled SNARE proteins, we report on the kinetics of SNARE complex formation observed at the single-molecule level. For this purpose, we have developed an advanced single-molecule FRET technique, in which we track not one, but up to 10 proteins at the same time while keeping the precision at the single-molecule level. The measured kinetics of SNARE complex formation shows strong, positive cooperativity. We finally discuss whether we can make two single-molecule measurements in one experimental setting, for example, detecting the moment of fusion pore opening while tracking formation of multiple SNARE complexes. Such experiment would reveal quantitative correlation between multimeric structure of SNARE proteins and its functional effect on fusion pore opening.

Collaborator: Dr. Yeon-Kyun Shin, Iowa State University and POSTECH.

### Bio sketch

Tae-Young Yoon is currently an associate professor of physics at KAIST. Dr. Yoon completed his all B.S. (1998), M.A. (2000) and Ph.D. (2004) degrees from the school of electric engineering at Seoul National University. He got postdoctoral training at University of Illinois at Urbana-Champaign (2005-2007) and opened his own lab at KAIST physics in 2008. Dr. Yoon's lab has been mainly interested in applying single-molecule fluorescence techniques to membrane proteins and their biology. But in 2011, he has obtained the grant of creative research initiative of Korea that will support 'Center for Single-Molecule Systems Biology center' for the next 9 years. In this new center, Dr. Yoon's group will strive to measure the real-time kinetics of protein-protein interactions, up to the single-molecule level and in a massively parallel manner, which allows for computational modeling of cell signaling at the systems biology level.



## Zooming in Cancer: What does imaging do for tumor biology?

이름 : 정의현 박사

직위 : 조교수

소속 : 광주과학기술원 (GIST)

기타 : ogong50@gist.ac.kr

<http://bio-scopy.gist.ac.kr>

### Abstract

*In vivo* imaging offers a unique opportunity to study cancer biology with animal model system. In this talk I illustrate the utilization of novel optical technologies for cancer detection and imaging complex behavior of cancer cells at various scales. At whole-body/tissue scale, I introduce whole-body bioluminescence imaging. A novel secreted *Gaussia* luciferase based assay can localize and quantify systemic tumor metastases to monitor tumor progression and response to treatments. At cellular scale, I introduce video-rate two-photon microscopy and a novel endomicroscopy to visualize the dynamic nature of tumor vasculature in a mouse brain and to trace cancer progression inside the gastrointestinal tract. At molecular scale, I describe the development of super-resolution microscopy based on the application of standing evanescent waves. The imaging technologies from whole-body to molecular level provide us fundamental insight into tumor biology and the development of translational therapeutic strategies.

### Bio sketch

Euiheon Chung, PhD, is an Assistant Professor of the Graduate-program of Medical System Engineering and School of Mechatronics at the Gwangju Institute of Science and Technology (GIST). After receiving B.S. and M.S. degrees from Korea Advanced Institute of Science and Technology (KAIST), Dr. Chung gained his PhD from the Harvard-MIT Division of Health Sciences and Technology (HST) Medical Engineering and Medical Physics program in 2007. His work involved in the invention of super resolution microscopy techniques. While in graduate school, he helped a biotechnology start-up company, Nanopoint Inc., as a technical consultant for the development of high-resolution imaging system based on his graduate work. In addition, he also worked for a medical venture company, Cambridge Devices Inc., to develop polarization-based fluorescence imaging for skin cancer detection. Since then he joined the Steele laboratory of Tumor Biology at Massachusetts General Hospital and Harvard Medical School as a post-doc. His research focuses on the creation of translational imaging technologies beyond proof-of-principle prototypes based on thorough understanding of the biological context and clinical needs.



## Micro/macro-scale optical imaging for medicine

이름 : 김법민, PhD

직위 : 정교수

소속 : 고려대학교 생체의공학과

기타 : 한국광학회 상임이사, 대한의용생체공학회 이사

### Abstract

Optical imaging uses light for visualization of molecules, cells, tissues and organelles in living organism. Scientists have investigated ways to overcome the intrinsic limitations of shallow light penetration and spatial resolution. As a result, various optical imaging techniques have been introduced. In this presentation, several optical imaging techniques including optical coherence tomography (OCT) and diffuse optical tomography (DOT) will be discussed. OCT has been commercialized in the field of ophthalmology and cardiology. It is currently being tested for feasibility in cancer detection, dermatology and image-guided therapy. We have developed several spectral domain (SD) OCT systems that provide high resolution and high image acquisition speed in the wavelength range of 1300 nm, 1000 nm and 800 nm. Polarization sensitive SD-OCT system at 1300 nm is used for functional imaging of tissues; separate 1000 nm SD-OCT system is proven to provide larger penetration depth over other wavelength range; the 800 nm SD-OCT system is used for dual focused imaging for ophthalmology which can image cornea and retina simultaneously for the first time.

A 24-channel DOT system was constructed using laser diodes and avalanche photodiodes for investigation of animal/human brains. We reported that the DOT system could be a new and useful neurotool for monitoring cerebral hemodynamics. Cortical areas in mice, rats and humans have been investigated with high temporal-resolution. We have also built a wireless DOT system with motion artifact rejection algorithm that can be used for moving objects.

### Bio sketch

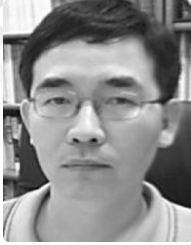
Beop-Min Kim received the B.S. degree in mechanical engineering from Korea University, Seoul, Korea, in 1989, and the M.S. and Ph.D. degrees in bioengineering from Texas A&M University, College Station, in 1991 and 1996, respectively.

He was a Predoctoral Fellow with the University of Texas M.D. Anderson Cancer Center, Houston, and University of Texas Medical Branch, Galveston from 1993 to 1996. From 1996 to 2001, he was with the Medical Technology Program, Lawrence Livermore National Laboratory, Livermore, CA, where he was the Staff Scientist. From 2001 to 2009, he was an Assistant/Associate Professor with the Department of Biomedical Engineering, Yonsei University, Wonju, Korea, where he was also the



Department Head and the Director of the Institute of Advanced Biomedical Engineering. He is currently a Professor in the Department of Biomedical Engineering, Korea University. His research interests include optical coherence tomography, near-IR spectroscopy in neuroscience, and second-harmonic generation microscopy.

Prof. Kim is currently a Board Member of the Optical Society of Korea and the Korea Society of Medical and Biological Engineering.



## MR 기반 세포영상

이름 : 문치웅, PhD

직위 : 부교수

소속 : 인제대학교 의용공학과 (신호 및 영상시스템 연구실)

기타 : 분자영상학회 대외협력이사

### 요 약

질병이 세포의 비정상적 현상에서 시작하여 인체의 조직 수준으로 확대된다면 세포 수준에서의 조기질병 진단은 질병의 예방 및 치료에 크게 기여할 수 있다. 자기공명영상 (MRI) 장치는 인체 내의 해부학적 정보뿐만 아니라 기능적 정보와 물질대사 정보를 비침습적 (non-invasive)으로 얻을 수 있는 최첨단 의료영상장비 중 하나이다. 임상 MRI 장치에서 일반 영상의 해상도는 0.1mm보다 낮아 인체 조직 수준에서 질병을 진단이 이루어지고 있다. 세포 또는 분자 수준의 영상을 위해서는 이 보다 훨씬 높은 해상도와 민감도를 가져야 하므로 새로운 영상획득 방법들을 필요로 한다. 특정 세포의 생화학적 또는 생리적 현상 감지할 수 있는 화합물을 붙인 T1또는 T2\* 조영제를 사용하여 간접적으로 세포의 변화를 영상화하는 연구가 활발하게 진행되고 있다. 또한 세포의 증식 분화에 따른 물질대사의 변화를 MR 분광 (spectroscopy)을 이용하여 비침습적으로 관찰하는 연구도 진행 중에 있다. MR을 기반으로 한 세포수준의 영상 및 분광 법의 현황과 전망에 대해 강의한다.

### 소 개

1979 ~ 1983 서강대학교 전기공학과 학사  
 1983 ~ 1991 한국과학기술원, 전기 및 전자, 석사·박사  
 1986 ~ 1987 미국 콜롬비아대학병원 방사선과 연구원  
 1991 ~ 1996 서울아산병원 아산생명과학연구소 선임연구원  
 1996 ~ 1999 삼성종합기술원 의료기기연구팀 전문연구원  
 2005 ~ 2006 미국 에모리 대학 의공학과 방문교수  
 1999 ~ 현재 인제대학교 의용공학과 부교수

### 연구분야 / 대외활동

신호 및 영상시스템관련 기술 중

- 1) MR 기반 줄기 세포 영상 및 분광, MR 기반 온도 영상 및 치료, 뇌 영상 분석
- 2) EMG 장치 등. 대한자기공명의과학회 교육 위원



## Recent Technological Advances in Diagnostic and Therapeutic Ultrasound

이름 : 유양모, PhD

직위 : 조교수

소속 : 서강대학교 전자공학과/바이오융합

### Abstract

Ultrasound imaging has become one of the most frequently used medical imaging modalities, accounting for almost 25% of all imaging examinations performed around the world since its introduction in the 1950s. Ultrasound imaging provides high-resolution real-time anatomical and/or physiological images. In addition, in the past decades, ultrasound image quality and its diagnostic capabilities have been significantly improved with engineering and technological innovations. Moreover, therapeutic ultrasound, called as high-intensity focused ultrasound (HIFU), has gained popularity in medical procedures. In this lecture, recent technological advances in diagnostic and therapeutic ultrasound imaging such as elastography, photoacoustic imaging and ultrasound-guided HIFU, will be reviewed. Also, some examples will be presented to demonstrate how these new technologies are clinically used.

### Bio sketch

Dr. Yangmo Yoo received the B.S. and M.S. degrees in Electronic Engineering from Sogang University in 1999 and 2001, respectively. After receiving the Ph.D degree in Bioengineering from the University of Washington (Seattle, WA, USA) in 2007, he joined in the Philips Healthcare (Bothell, WA, USA) as a Systems Design Engineer. Dr. Yoo is currently an assistant professor in the Department of Electronic Engineering and Interdisciplinary Program of Integrated Biotechnology at Sogang University. Dr. Yoo's research interests include diagnostic and therapeutic ultrasound, photoacoustic imaging, medical signal and image processing, and high-performance computing architecture for medical applications.



## Advances in PET/MRI Researches

이름 : 이재성, PhD

직위 : 부교수

소속 : 서울의대 핵의학교실 및 WCU 뇌인지과학과

기타 : 2013 IEEE MIC Chair, BMEL Managing Editor

### Abstract

Although there are many benefits of PET/CT over the stand-alone PET, several limitations of PET/CT have also been identified. Physiologic or voluntary motion of body and organs between the CT and PET scans often causes artifacts in the fused images because they are not simultaneously acquired. In addition, radiation exposure during the PET/CT examination is twice that of the standalone PET or CT. Therefore, if the PET/MRI is available, it will be especially useful in pediatric studies and repeated scans for treatment monitoring. Another advantage of PET/MRI is the higher soft tissue contrast in MRI. Therefore, the PET/MRI is expected to yield superior diagnostic accuracy, particularly in brain studies, to PET/CT. In addition, it would also be useful in local tumor assessment and whole-body staging where higher soft tissue contrast of MRI is beneficial. In this lecture, the advances in PET/MRI systems and related researches will be illustrated.

### Bio sketch

BA in Electrical Engineering and PhD in Biomedical Engineering, Seoul National University, 2001; Postdoctoral Fellow, Nuclear Medicine and Radiation Science, Johns Hopkins University, 2002-2003; Assistant/Associate Professor of Nuclear Medicine, Biomedical Sciences, and Radiation Applied Life Science, Seoul National University, 2005 - present.

General Secretary, IEEE Nuclear and Plasma Science Society Seoul Chapter; Publications Director, Korean Society of Medical and Biological Engineering; Publicity Director, Korean Society of Medical Physics; Nuclear Sciences Director, Korean Society of Nuclear Medicine; 2013 IEEE Medical Imaging Conference (MIC) Chair; Managing Editor, Biomedical Engineering Letters; Associate Member, Korean Academy of Science and Technology (KAST)

His work involves the acquisition of biologically relevant and clinically useful information from the biomedical image data set. With this ultimate goal of the research, he is focusing on the development of new hybrid imaging devices and image processing technologies for the functional and molecular imaging modalities.



## Why High Field MRI?: Can We Use It?

이름 : 유형석, PhD

직위 : 조교수

소속 : 울산대학교 전기공학부 의공학전공

### Abstract

High magnetic field magnetic resonance imaging (MRI) systems, with static fields of 4 T, 7 T, and 9.4 T, have higher signal to noise ratios (SNR) and higher resolutions in the images. This presentation will focus it on current problems and developments in the MR Imaging field. Better image resolution and higher tissue contrast are achieved by increasing the strength of the static magnetic field  $B_0$ . Scanners with  $B_0 > 4$  Tesla (Frequency  $> 160$  MHz) are categorized as “High Field”. Arrangements for excitation and reception of the  $B_1$  field become now real RF structures with propagation effects and the involvement of an appreciable electric field. The convex optimization technique has been used to obtain the optimum excitation parameters with iterative solutions for homogeneity in a selected region of interest. The pseudoinverse method has been also used to find the optimal solution. The simulation results for 9.4 T and 7 T MRI systems are discussed in detail, and experimental results obtained in a phantom are also presented. Variations with the number of RF coil elements and different regions of interest, and the specific absorption rate (SAR) evaluation are also discussed.

### Bio sketch

Hyungsuk Yoo was born in Gyeongsan, Korea, in 1977. He received the B.S. degree in electrical engineering from Kyungpook National University, Daegu, Korea, in 2003, and the M.S. and Ph.D. degrees in electrical engineering from the University of Minnesota, Minnesota, USA, in 2006 and 2009, respectively. In 2009, he was a Post-Doctoral Associate with the Center for Magnetic Resonance Research, University of Minnesota. In 2010, he joined the Cardiac Rhythm Disease Management (CRDM), Medtronic, Minnesota, USA, as a Senior MRI Scientist. He is currently an Assistant Professor in the Department of Biomedical Engineering, School of Electrical Engineering, University of Ulsan, Republic of Korea.

His research interests include electromagnetic theory, numerical methods in electromagnetics, metamaterial, antennas, implantable devices, and magnetic resonance imaging in high magnetic field systems.

Dr. Yoo was awarded Third Prize for the Best Student Paper at the 2010 IEEE Microwave Theory and Techniques Society (MTT-S) International Microwave Symposium.



2011년도 제43회 대한의용생체공학회 춘계학술대회

## 신진연구자 초청강연



- **A Systems Approach to Engineering Cancer Nanotechnologies**  
박지호 교수  
카이스트 바이오및뇌공학과
- **Lab on a chip Technologies for cell, protein and DNA analysis**  
천홍구 교수  
고려대학교 생체의공학과
- **In-vivo optical measurement of activity-dependent fluorescence change in the mouse striatum**  
전상범 교수  
이화여자대학교 전자공학과
- **Auditory Nerve Response to Electric Stimuli**  
우지환 교수  
울산대학교 의공학과



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## A Systems Approach to Engineering Cancer Nanotechnologies

이름 : 박지호

직위 : 조교수

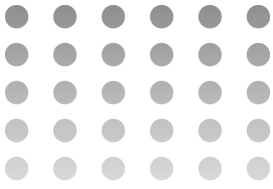
소속 : 카이스트 바이오및뇌공학과

### Abstract

Over the past decade, widespread progress in nanotechnology has produced an impressive array of nanodevices with powerful electromagnetic and therapeutic properties. Nonetheless, our capacity to precisely home these materials to regions of disease in vivo has remained very limited and, despite three decades of research, ligand-targeted nanomedicines have yet to provide a benefit to patients. A fundamental limitation of current approaches to nanoparticle targeting is that they lack mechanisms of communication and amplification through which specific targeting events could assist the targeting of materials still in circulation. In this talk, I will discuss the development of nanosystems where a “cocktail” of two distinct nanomaterials work in concert within the bloodstream to amplify tumor targeting and improve therapy in vivo, which was inspired by examples of communication in natural targeting systems (e.g. inflammatory cell recruitment to infection). Specifically, the first activator nanoparticles initially targets tumors and, after arrival, sends signals through the biological cascades or directly to the second responder (diagnostic or therapeutic) nanoparticles to recruit them into tumors efficiently. This approach stands in contradistinction to all current nanotechnologies that utilize formulations of nearly-identical nanoparticles that perform competitive tasks without cooperation in vivo. I believe this work motivates a new paradigm of “systems nanotechnology” for biomedicine, where multi-component, interactive nanoparticle systems are engineered to improve the sensing and treatment of diseases in vivo.

### Bio sketch

Ji Ho (Joe) Park received his B.S. degree in Metallurgical Engineering in 2002 and his M.S. degree in Medical Sciences from Yonsei University, South Korea in 2004. His M.S. thesis work involved the development of biodegradable polymer conduits for peripheral nerve regeneration in tissue engineering fields. He came to the States in 2004 and received his Ph.D. degree in Materials Science from University of California, San Diego in 2009. His Ph.D. thesis work involved the development of biosafe nanomaterials and cooperative nanosystems for cancer diagnosis and therapeutics in the laboratory of Prof. Michael J. Sailor in Chemistry and Bioengineering. His Ph.D. work was done in strong collaboration with the laboratory of Prof. Erkki Ruoslahti in Cancer Biology at Burnham-Sanford Medical Research Institute at UC, Santa Barbara and with the laboratory of Prof. Sangeeta Bhatia in



Bioengineering at MIT. He performed his post-doctoral studies under the direction of Prof. Peidong Yang in Chemistry at University of California, Berkeley in 2009-2010 working on the nanowire-based systems for biological and energy applications. He joined the faculty in the Department of Bio and Brain Engineering at KAIST in October 2010. He is the author of over 30 research publications, in subjects related to cancer nanotechnology, materials chemistry, biomaterials, nanomaterials and tissue engineering. He has 5 patents or patents pending.





## Lab on a chip Technologies for cell, protein and DNA analysis

이름 : 천홍구, PhD

직위 : 조교수

소속 : 고려대학교 생체의공학과

### 요 약

적절한 질병진단만 받을 수 있어도 아프리카를 비롯한 저개발국에서 매년 수백만의 생명을 살릴 수 있다. Lab on a chip 기술은 선진국의 첨단 중앙집중식 진단시스템과 저개발국의 부족한 리소스 사이를 메워, 저개발국의 열악한 의료환경에서 주요사망원인 질병진단을 저렴하고, 쉽고, 정확하게 할 것이다. 본 강연에서는 이와 같은 Global health의 개선을 위한 Lab on a chip 기술의 응용을 세포 분석, 단백질 시료의 분리 및 검출, DNA 검사 면에서 살펴볼 것이다. 특히, Lab on a chip 시스템이 연구실 차원에서의 proof of concept를 넘어 실제 임상에 쓰일 수 있는 성능을 갖게 하기 위한 여러 기술적 혁신에 대한 내용이 포함될 것이다.

### 소 개

천홍구 박사는 고려대학교 생체의공학과 조교수입니다. 그는 서울대학교 전기공학부를 졸업한 뒤, 동 대학원의 김희찬 교수 지도로 의용생체공학 석사 및 박사 학위를 받았습니다. 의료기기 벤처회사인 엘바이오에서 연구소장으로 7년간 근무하면서 원격의료를 위한 가정 및 병원용 장비들을 상품화하였습니다. 2006년부터 2010년까지는 University of North Carolina at Chapel Hill 화학과에서 Lab on a chip 기반의 분석화학을 연구하였으며, 2010년부터 올해 초까지 서울대학교 차세대융합기술연구원에 연구교수로 재직하였습니다. 그의 주된 연구 관심사는 Lab on a chip 기반의 생/화학 물질 분석, 약물 스크리닝, DNA sequencing입니다.



## In-vivo optical measurement of activity-dependent fluorescence change in the mouse striatum

이름 : 전상범, PhD

직위 : 전임강사

소속 : 이화여자대학교 전자공학과

### Abstract

The use of genetically encoded fluorescence probes is rapidly increasing especially in neuroscience. However, it still remains challenging to optically monitor neural activity from deep brain areas in awake animals. In this study, we propose a novel method to monitor neural activity in striatum of mice expressing activity-dependent fluorescence using fiber optics and time-correlated single photon counting. Two optic fibers for excitation and detection were implanted into the striatum region along with a multichannel microelectrode array. First, we used the synaptophluorin transgenic mouse which has a pH-sensitive EGFP derivative linked to the vesicle protein increasing fluorescence upon exocytosis. To examine the fluorescence response to external stimuli in awake, behaving animals, an auditory stimulus of white noise was presented. Transient fluorescence increases were induced by the sound stimulation. The response was coincident with increased gamma oscillation of local field potential. Second, genetically-encoded  $\text{Ca}^{2+}$  indicator, GCaMP3 was expressed selectively in the neurons expressing dopamine type-1 receptors (D1) by injecting adeno-associated virus (AAV) with the floxed GCaMP3 sequence into the striatum of transgenic mouse expressing CRE recombinase in D1 neurons. When the animals were performing specific tasks, the activity of D1 neurons was detected as a fluorescence change. These findings indicate that we can use in vivo photometry to measure fluorescence changes that report physiological changes in brain of the animal.

### Bio sketch

Sang Beom Jun is an assistant professor in Department of Electronics Engineering at Ewha Womans University. He received the B.S. degree in Electrical Engineering and the M.S. and Ph.D. in Electrical Engineering and Computer Science from Seoul National University. From 2007 to 2010 he was trained as a postdoctoral fellow at Wadsworth Center and Laboratory for Integrative Neuroscience at National Institutes of Health/National Institute on Alcohol Abuse and Alcoholism in USA. From 2001 to 2007, he worked for a startup company, Nurobiosys Inc. corp. to develop cochlear implant and deep brain stimulation systems for clinical applications. His research interests fall within neural engineering and neuroscience including patch-clamping of single neuron, cultured neural networks on microelectrode arrays, in vivo neural recording and neural prosthetics.



## Auditory Nerve Response to Electric Stimuli

이름 : 우지환, PhD

직위 : 조교수

소속 : 울산대학교 의공학과

### Abstract

Most neural prostheses use electric stimuli to excite nerve fibers to restore organ function. Cochlear implant employs electric pulse trains to provide auditory sense to persons who loss hearing profoundly. Understanding auditory nerve responses may help designs of cochlear implant stimulus protocols and interpretation of clinical neural-measures.

This study describes the auditory nerve responses to electrical stimulation observed in the responses of cat auditory nerve fibers (ANFs) and shown by a computational biophysical ANF model that simulate rate adaptation.

The computational model incorporates the anatomical component of a complete cat ANF. The model that also included stochastic voltage-gated channels and a novel element that tracks external K<sup>+</sup> concentration results in rate adaptation and changes in spike amplitude similar to those reported for feline ANFs. The results show that the model can predict responses to single-pulse and pulse-train stimuli consistent with cat ANF data and suggests possible effects of electric stimuli on ANF responses.

Collaborators: Charles Miller, PhD and Paul Abbas, PhD, University of Iowa, Iowa City, USA

Supports: NIH R01-DC0006478 and KRF 2006-352-H00007

### Bio sketch

Jihwan Woo is Assistant Professor of the Department of Biomedical Engineering at the University of Ulsan. He received the B.S. degree in mechanical engineering from KAIST, Daejeon, Korea, in 1996, and Ph.D. degree in biomedical engineering from Hanyang University, Seoul, Korea, in 2006. He did postdoctoral research in otolaryngology at the University of Iowa, Iowa City, USA. His current research interests include neural modeling of the electrically stimulated cochlear nerve and auditory electrophysiology.



2011년도 제43회 대한의용생체공학회 춘계학술대회

## 의료기기 특별강연

- **의료기기 국제표준과 기준규격**

이상학 연구소장  
(주)멕아이씨에스

- **의료기기 국제표준과 기준규격**

안원식 교수  
서울대학교병원 임상시험센터/마취통증의학과



KOSOMBE







## 의료기기 국제표준과 기준규격

이름 : 이 상 학

직위 : 연구소장

소속 : (주)멕아이씨에스

### 요 약

의료기기를 개발하면서 최종 사용자에게 제품을 판매하기 위해서는 국내의 경우 식품의약품의 품목허가와 외국의 경우 해당규격의 규격을 획득해야 한다. 규격은 최종 사용자가 제품을 사용하는데 최소한의 안전성과 유효성을 확보하는데 있다. 그 규격의 중요성은 해가 바뀔 때마다 더욱더 강화되고 있는 추세이다. 즉 사용자의 권리를 더욱 중요시 생각하고 의료사고 예방을 하면서 사용자가 가장 많이 사용하는 분야에 규격제정을 강화하고 있다. 이렇듯 의료기기 제품에 대해 엄격한 규격을 적용하고 있는데, 지금까지는 의료기기에 적용되고 있는 규격을 이해하고 제품에 어떻게 적용되는가 생각하였다. 그러면 도대체 규격은 어떻게 정해지고 어떻게 시행되는지 궁금한 면이 많이 있었다. 또한 단순히 의료기기 개발자로서 국제규격에 따른 의료기기 규격을 제품에 적용하는 현실에 만족하고 있어야만 하는지 고민이 있었다. 2009년부터 기술표준원의 ISO TC121 분과 활동을 하면서 우리가 조그만 관심만 가지면 우리가 규격을 제정하고 개발 제품에 적용할 수 있음을 알게 되었다. 그래서 의료기기 개발자임장에서 왜 규격을 정해야 하고, 어떻게 국내규격과 국제표준에 참여할 수 있는지 알아보려고 하겠다.

### 소 개

- 1985 ~ 1989 한양대학교 공과대학 섬유공학과 (학사)
- 1989 ~ 1991 한양대학교 일반대학원 섬유공학과 (석사)
- 2003 ~ 2007 (주)바이오닉스 연구소장
- 2007 ~ 현재 (주)멕아이씨에스 연구소장
- 2009 ~ 현재 기술표준원 '기술위원회 121 마취기 및 호흡회로' 위원

### 개발분야

- 중환자용 인공호흡장치
- 환자감시장치
- 마취기



## 의료기기 국제표준과 기준규격

이름 : 안원식, MD, PhD

직위 : 의료기기 연구실장

소속 : 서울대학교병원 임상시험센터/마취통증의학과

### 요 약

임상 의사로서 다양한 의료기기를 사용하면서 ‘호흡회로와 기관내 튜브의 연결부위가 맞는 것이 있고 틀리는 것이 있는데, 이런 것은 누가 어떻게 정하였을까?’, ‘여러 내시경 회사 제품이 서로 호환되었으면 좋겠다!’ 하는 생각을 가끔 하곤 하였다. 한편, 여러 좋은 선생님의 조언을 받아 의료기기 임상시험을 접하고, 식품의약품안전청에 용역과제를 수행하면서 의료기기 허가 과정 중에 어떤 기준이 있는 있다는 것을 막연히 알게 되었다. 이 두 가지 관점이 서로 비슷한 것 같으면서 뭔가 다른 것이 있는 것 같은데, 어떻게 다른지 꼭 집어서 설명하지 못하고 관련된 업무를 한 동안 수행하였다. 앞의 생각 중에 첫 번째 생각에 대한 답은 ISO, IEC, KS 등으로 대표되는 국제표준, 국내표준이고, 두 번째 생각인 식약청 허가 기준은 ‘기준규격’이라는 것이라는 것을 아는데 2년이 걸렸다. 그리고, 의료기기 국제표준과 식약청 기준규격 사이에 어떤 관계가 있는지 파악하는데도 1년이 소요되었다. 의료기기 국제표준과 기준규격이라는 개념은 특정 교과서에 명시되어 있지 않지만, 장치 임상진료에 적용할 것을 전제로 의료기기 초기 모델을 개발하는 의공학자나 진료 현장에서 아이디어를 내고, 의료기기 부작용을 보고하는 임상 의사들에게 꼭 필요한 것으로 생각된다. 또한, 의료기기 국제표준과 기준규격의 개발에 의공학 전공자가 기여할 것이 많기에 어떤 방식으로 참여할 수 있는지에 대해서도 알아보도록 하겠다.

### 소 개

#### 학력

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#### 논문

- 맥박산소포화도 측정 알고리즘에 존재하는 가정 (Assumption)과 임상적 해석
- 세 가지 혈압 측정법과 측정값의 비교
- 기화기 고장으로 발생한 전신마취 중 각성
- 마취와 수술 관련 병원 내 사망률
- 심박출량 측정의 문제점과 임상적 해석

#### 관심분야

- 생체 신호 분석, 마취와 관련 의료기기 개발
- 마취 관련 안전



2011년도 제43회 대한의용생체공학회 춘계학술대회

## ORAL PRESENTERS



KOSOMBE



**Cardiovascular Engineering****O1-1 박출량과 박동성 조절이 가능한 맥동 펌프의 개발**

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이종민<sup>1,5</sup>

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<sup>4</sup>경북대학교 기계공학부

<sup>5</sup>경북대학교 의학전문대학원 영상학교실

In this study, development of a pulsatile pump which could control its output volume and pulsatility was conducted for application of this system on atherosclerosis studies. The pulsatile pump system was produced to control total output volume (designated to cardiac output), frequency (heart rate), and duty ratio (time phases of systole and diastole). Based on these functions, the pump could generate various forms of pulsatile flow. The pump consists of cylinder and piston, crank, ducts, check valve, DC motor, power supply, and controller circuit. Rotational motion of motor transmits to crank, and then the crank imbibe/discharge fluid by converting up and down motion of piston. To validate the pulsatile flow pump, the flow evaluation using both phase-contrast MR imaging and particle image velocimetry (PIV) were conducted.

**O1-2 심박조율 기능을 갖춘 박동형 좌심실보조장치의 개발**

김유석<sup>1</sup>, 최성욱<sup>2</sup>

<sup>1</sup>강원대학교 기계메카트로닉스공학과

<sup>2</sup>강원대학교 기계의공학학과, 강원대학교

의료 · 바이오신소재융복합연구사업단

In this paper, we developed the pacemaker that increase the survival rate and treatment effect of cardiac disease patients using VAD. The electrode of pacemaker is positioned apex of heart where placed VAD's cannula for influx of blood. It is effective method that can transmit a electrical stimulation directly to purkinje fiber of myocardium. In particular, by using the pacemaking of patient's heart and the VAD simultaneously can synchronize or asynchronize the pulse wave of heart, we will demonstrate the performance and safety of pacemaker with VAD by animal experiments.

**Medical Imaging****O1-3 로봇 수술을 위한 영상에서의 출혈 검출 및 인지**

류지원<sup>1</sup>, 최재순<sup>2</sup>, 김희찬<sup>3</sup>

<sup>1</sup>서울대학교 대학원 협동과정 바이오엔지니어링

<sup>2</sup>고려대학교 의과대학 BK21 의과학사업단, 한국인공장기센터

<sup>3</sup>서울대학교 의과대학 의공학교실, 의학연구원

의공생체공학연구소

Real-time vision-guided hemorrhage recognition during robotized surgery was implemented by segmenting and tracking of blood boundaries using color and texture factors. Hemorrhage region is difficult to detect accurately due to noisy observations and occlusions during the surgery. To increase reliability tracking hemorrhage in robotized surgery, computer vision techniques are applied for automatic recognition of the current surgical state. In this paper, continuous hemorrhage boundary segmentation and tracking using energy-efficient detection techniques are proposed.

**U-Health, eHealth Technology****O1-4 모바일 기반의 만성창상 (욕창) 원격상담 기술 개발 및 유용성 평가**

허찬영, 김지은

분당서울대병원 성형외과

The objective of the study lies in developing the smartphone-based application to biologically check bed sore for the remote face-to-face counseling and the effectiveness of it. After medical doctors' assessment and advice for the patients' bed sore with four or six PSST standards, they are compared and analyzed again with the same tool by confirming the photos, videos and medical examination data on the web uploaded by smartphone. The conditions of the patients' bed sore for the first visit and the visit after four weeks were checked and compared to measure the effects. The effectiveness had been confirmed with more than 80 percent of consistence rate except for the size, and the treatment proved positive except for the case of patients with septic condition.

**O1-5 일상생활간 지속적 뇌 모니터링을 위한 순간 전류 구동 16채널 fNIRS 모듈 설계 및 성능 평가**이종민<sup>1</sup>, 백현재<sup>1</sup>, 박광석<sup>2</sup><sup>1</sup>서울대학교 공과대학 협동과정 바이오엔지니어링 전공<sup>2</sup>서울대학교 의과대학 의공학교실

Brain Computer Interface (BCI) and Brain Monitoring (BM) techniques have been growing for past decade. Non-intrusive and non-invasive BCI and BM system can be realized only by using EEG and NIRS. We made portable-and-wearable fNIRS system using peak forward current modulation of LED for generating high power output and power consumption reduction. For validation of the system, blood flow of arm and left frontal lobe are measured. Experimental results show that the fNIRS system can detect cerebral hemodynamics. Future system with calibration of signal can be used for BCI and BM by combining with technologies such as pattern recognition.

**Biomedical Optics****O2-1 이광자 현미경과 빛간섭 단층 촬영의 결합 시스템을 이용한 마우스 소장 이미징**정보수<sup>1</sup>, 남효석<sup>2</sup>, 장민성<sup>3</sup>, 왕태준<sup>3</sup>, 양보기<sup>3</sup>, 장명호<sup>3</sup>,  
도준상<sup>1,2,3</sup>, 김기현<sup>2,3</sup><sup>1</sup>포항공과대학교 시스템공학부<sup>2</sup>포항공과대학교 기계공학과<sup>3</sup>포항공과대학교 융합생명공학부

We present a combined high-speed two-photon microscopy (TPM) and optical coherence tomography (OCT) which can provide complement information of in vivo tissues: molecular and cellular information with TPM and tissue structure information with OCT. This combined system can do simultaneous imaging in principle as using individually optimized sources. This combined system was applied to image the ex-vivo intestine of a mouse model. Micro-structures of the intestine villi including morphology and immune cells within the villi were visualized by the combined system.

**O2-2 단일벽 탄소 나노튜브 조영제를 이용한 광음향 단층 촬영 기술**구자성<sup>1</sup>, 이창호<sup>2</sup>, 김철홍<sup>3</sup>, 김지현<sup>4</sup>, 오정환<sup>5</sup><sup>1</sup>부경대학교 메카트로닉스공학과<sup>2</sup>경북대학교 전자전기 컴퓨터 공학부<sup>3</sup>버팔로 주립대학교 의공학과<sup>4</sup>경북대학교 전자전기 컴퓨터 공학부<sup>5</sup>부경대학교 의공학과

Photoacoustic tomography (PAT) is an imaging technology that can provide high spatial resolution and strong optical absorption contrasts. PAT is able to produce high-resolution images of vascular structures, solid tumors, angiogenesis, and internal organs in vivo due to endogenous contrasts such as hemoglobin of melanin. However, because many samples will not show an endogenous contrast for photoacoustic tomography, it is necessary to select suitable contrast agents. In this study, we demonstrated the possibility of single walled carbon nanotubes (SWCNT) as a contrast agent for PAT molecular imaging.



**Medical and Bioinformatics****O2-3 템플릿 표면 모델 기반 3차원 상부 경추 형태 복원 기법**김재일<sup>1</sup>, 닐 로버츠<sup>2</sup>, 박진아<sup>1</sup><sup>1</sup>KAIST 전산학과<sup>2</sup>Clinical Research Imaging Centre(CRIC), Edinburgh, Scotland

For clinical and fundamental studies in upper cervical region including skull, Atlas, Axis and surrounding muscles, the acquisition of a subject-specific shape of upper cervical spine is indispensable. With advantages in imaging details of tissues as well as having no radiation exposure, MRI is a good choice for such studies. However, unlike CT, there are some difficulties in reconstructing the subject-specific spine shape from Brain MRI data due to unclear boundaries of bones in the images. We develop a novel shape reconstruction technique using template surface models to obtain a subject-specific model of upper cervical spine from 3D MR images. We present a promising preliminary result of a reconstructed pair of Atlas and Axis, where the template meshes in a different configuration are deformed to conform its shape with respect to the target image data.

**Medical Imaging****O2-4 영상분할 기반 전신 PET/MR 감쇠보정의 표준섭취계수 평가**김중현<sup>1</sup>, 이재성<sup>1</sup>, 송인찬<sup>2</sup>, 이동수<sup>1</sup>서울대학교 <sup>1</sup>핵의학과, <sup>2</sup>영상의학과

For the attenuation correction (AC) in PET/MRI system, segmentation-based methods which categorize tissue groups based on MRI intensities are mostly used. In this study, the possible bias in the SUV estimation was evaluated using 3- and 4-segment (3S and 4S) AC in the cancer patients with bone and liver lesions. Forty patients who had spine or liver lesions and underwent 18F-FDG PET/CT scan were participated. PET sinograms were reconstructed using CT, 3S, and 4S AC maps, and mean SUVs in the lesion were compared. In 3S AC, the SUV of spine lesion was considerably under-estimated, however in 4S AC, it would be acceptable. In liver lesions, the segmentation-based AC yielded ~10% negative bias in SUV regardless of the inclusion of bone segment, due to the higher tissue density of liver than other soft-tissue organs.

**O2-5 뇌에서의 [11C]sertraline 동적 PET스캔 적정시간선정 및 단순 정량화 방법유용성평가**김지후<sup>1</sup>, 김수진<sup>2</sup>, 이재성<sup>1</sup>, LathikaHoigebazar<sup>1</sup>, 이학정<sup>1</sup>, 신광희<sup>3</sup>, 유경상<sup>3</sup>, 안원식<sup>4</sup>, 정재민<sup>1</sup>, 이동수<sup>1</sup><sup>1</sup>서울대학교 의과대학 핵의학교실<sup>2</sup>분당서울대학교병원 핵의학교실<sup>3</sup>서울대학교 의과대학 임상약리학교실<sup>4</sup>서울대학교 의과대학 마취통증의학교실

The aim of this study was to determine the optimal scan duration of dynamic PET studies for the accurate estimation of kinetic parameters for [<sup>11</sup>C]sertraline and the feasibility of semi-quantitative approach without arterial blood sampling for the assessment of distribution volume ratio (DVR) in human brain. Dynamic PET (duration: 90~120 min) imaging of [<sup>11</sup>C]sertraline and 3D T1 SPGR MRI scans were performed in 5 healthy male volunteers (mean age 32.4 y). Total distribution volume ( $DV=K_1 / k_2$ ) for each ROI and distribution volume ratio (DVR) relative to cerebellum were calculated using the single-tissue compartment model. In addition, ratio between the SUV of each ROI and that of cerebellum (SUVr) was computed and correlated with the DVR. Dynamic PET scan time longer than 50 min was required for the accurate estimation of DV of [<sup>11</sup>C]sertraline in normal human brain. In addition, SUVr (50~90 min) was the feasible simplified quantitative parameter reflecting the DVR of this tracer.

## Medical Nano and Microtechnology

### O3-1 큰 변형이 가능한 PDMS 기반의 신경 자극용 평면형 전극

추남선<sup>1</sup>, 유순기<sup>1</sup>, 김소희<sup>1,2</sup>

<sup>1</sup>GIST 기전공학부

<sup>2</sup>GIST 의료시스템공학 학제 전공

This paper describes a surface electrode based on PDMS for therapeutic cortical stimulation aiming at providing stable stimulation even in highly deformed condition. While PDMS based electrodes are not causing injury in implanted tissue, they have some problems such as micro crack formation during metal deposition and high water absorption in PDMS substrate. To solve these problems, an intermediate thin film layer of parylene C was deposited on PDMS substrate. The results of electrochemical characterization of the electrode, soaking test, and bending test demonstrated mechanical and electrical stability of our PDMS electrodes, indicating the reliability in stable cortical stimulation.

## Neural Engineering

### O3-2 청각 자극의 선택적 집중을 이용한 실시간 뇌-컴퓨터 인터페이스 개발

김도원<sup>1,2</sup>, 황한정<sup>1</sup>, 임정환<sup>1</sup>, 김한성<sup>1</sup>, 임창환<sup>2</sup>

<sup>1</sup>연세대학교 보건과학대학 의공학부

<sup>2</sup>한양대학교 전기생체공학부 생체공학전공

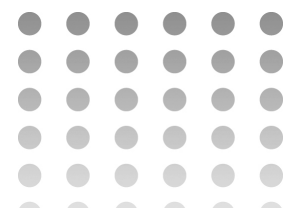
In the previous study, we have successfully shown that brain-computer interface (BCI) using auditory steady-state response (ASSR) is appropriate for patients who have difficulties in using vision-based BCI. However, the suggested paradigm was tested in offline study and thus its feasibility in practical applications was not proven. In this study, we have developed an online ASSR-BCI system based on our previous study. Our online BCI system showed an accuracy of 71.4%, suggesting that the system is appropriate for practical applications.

### O3-3 표면 미세도형의 기하학적 특징이 축색돌기 성장에 미치는 영향

장민지, 남윤기

KAIST 바이오및뇌공학과

Guiding axons in the culture has been of interest, which determines the direction of signal transmission within networks. Here we report that the geometry of surface micro-figures printed on the substrates influence to the orientation of initiating axons during neurogenesis. We fabricated micro-figures composed of the mixture of poly-L-lysine and synthesized laminin A chain on the glass coverslips and hippocampal neurons dissociated from E18 rats were cultured on those patterned substrates. We found that an axon, which was much longer than other neurites, was preferentially initiated from the vertex angle of long isosceles triangle. This study showed that protruding neurites, in particular axons, could recognize the geometry of surface adhesive regions and also had directional preference for constructing neurites in accordance with the geometric trait of those regions. In addition, these results suggested that printed micro-figures can give the concept of design into culturing neuronal networks.

O3-4 **완전이식형 인공와우용 전류 자극기 설계**김진호<sup>1</sup>, 박정환<sup>1</sup>, 강민규<sup>2</sup>, 민규식<sup>1</sup>, 송윤규<sup>2</sup>, 김성준<sup>1</sup><sup>1</sup>서울대학교 공과대학 전기공학부<sup>2</sup>서울대학교 융합과학기술대학원 나노융합학과

Previously, we reported on a novel totally implantable cochlear implant based on biomimetic piezoelectric-acoustic sensor. Also, we designed and fabricated an amplifier array and a digital processing module which were interfaced with the sensor. The purpose of this study was to design the current stimulator stage for the totally implantable cochlear implant. The current stimulator can stimulate sixteen electrode sites simultaneously, enabling current steering and focusing for spatially precise cochlear nerve stimulation.

O3-5 **Spike train decoding을 이용한 다채널 동시 전기자극에 대한 변성망막의 시공간적 정보 인코딩 특성 관찰**류상백<sup>1</sup>, 안근노<sup>2</sup>, 구용숙<sup>2</sup>, 김경환<sup>1</sup><sup>1</sup>연세대학교 보건과학대학 의공학과<sup>2</sup>충북대학교 의과대학 생리학 교실

Since retinal implant transmits visual information by electrical stimulation to retina, stimulation strategy should be developed based on understanding of response properties of retinal ganglion cells to electrical stimulation. In this study, we investigated encoding properties of retinal ganglion cells of degenerated retina by the reconstruction of spatiotemporal visual information which is transmitted by electrical pulse trains whose amplitudes are modulated according to two independent time series.

**Medical and Bioinformatics**O4-1 **의료용 장갑과 콘돔에서의 시험평가방법 확립에 관한 연구**

최승호, 이승영, 서무엽, 장동혁, 맹은호

한국화학융합시험연구원 헬스케어연구소

Medical gloves, including surgeon's and patient examination gloves, are used to prevent transmission of a wide variety of diseases to both patients and health care personnel. The objective of this study is to verify the test method for determination of removable surface powder, water-extractable protein and antigenic protein in medical glove, the test method for measurement and determination of lubricant for condom and the test method for determination of talc on medical glove and condom. At first, the safety of powder and latex used in medical glove and condom was investigated and FDA guidelines, international standards such as ISO, ASTM were reviewed. Also, tests were performed using final product and its results were validated using statistical analysis.

## Medical Nano and Microtechnology

### O4-2 크기조절이 가능한 배상체 생산을 위한 매니스커스를 이용한 오목한 마이크로 웰 어레이 마이크로 유체 칩

정기석, 전예슬, 송지훈, 이상훈  
고려대학교 보건대학 생체의공학과

In this study, we developed a novel method to self-organized large number of multiple deep concave wells in PDMS microfluidic channel using meniscus induced by surface tension of liquid PDMS prepolymer without complicated process. The size of concave well was tunable and the shape was reproducible. The murine EBs were successfully formed with minimized loss of cells and simply harvested. We have performed to confirm 3 germ layers of EB and induced differentiated to neuron.

including pH and salt concentration. In this paper, we present a nanomechanical method for monitoring the conformational change of DNA molecules under various experimental conditions. i-motif DNA was used a model sample, a given quantity of which was immobilized on the AFM cantilevers. In order to investigate the effect of pH and valence state of cation, the experiments were performed under various liquid environments. We have succeeded in the real-time detection of the conformational change of i-motif DNA through AFM cantilever bending experiments. In addition, it was confirmed that the valence state of cation as well as the pH variation strongly affected the structural change of i-motif DNA.

### O4-3 유전체 박막을 이용한 표면플라즈몬공명 바이오센서의 감도향상

조창희, 김낙현, 정우경, 변경민  
경희대학교 전자정보대학 생체의공학과

In this study, we demonstrate that surface plasmon resonance (SPR) structure with a thin dielectric ( $\text{Al}_2\text{O}_3$ ) layer on a silver film can be used to achieve a high sensitivity as well as to prevent the silver oxidation. Our numerical results show that a silver substrate with a 70-nm thick  $\text{Al}_2\text{O}_3$  layer can significantly increase the sensitivity by more than 5 times. Also, by calculating the near-field characteristics of the proposed SPR system, this enhancement is found to be associated with an increase of plasmonic field amplitude at the sensor surface.

### O4-4 마이크로캔틸레버를 이용한 i-motif DNA의 구조변화에 미치는 화학적환경에 대한 연구

정수호<sup>1</sup>, 정휘현<sup>1</sup>, 박진성<sup>2</sup>, 양재문<sup>3</sup>, 이상우<sup>1</sup>, 엄길호<sup>2</sup>, 윤대성<sup>1</sup>, 권태윤<sup>1</sup>  
<sup>1</sup>연세대학교 의공학부  
<sup>2</sup>고려대학교 기계공학부  
<sup>3</sup>연세대학교 의과대학

A DNA molecule with specific base sequence sensitively changes its 3D structure (conformational structure) at the nanoscale under variation of external environmental factors

## Tissue Engineering and Biomaterials

### O4-5 서방형 약물전달을 위한 멀티 채널& well로 구성된 마이크로칩

이승호<sup>1</sup>, 박민<sup>1</sup>, 박천권<sup>1</sup>, 이지은<sup>1</sup>, 최영빈<sup>1,2,3</sup>

<sup>1</sup>서울대학교 바이오엔지니어링 협동과정

<sup>2</sup>서울대학교 의과대학 의공학교실

<sup>3</sup>서울대학교 의학연구원 의용생체공학연구소

We developed a drug-delivery microchip (i.e., DDC) with a simple structure for sustained drug release. The chip was made of biocompatible poly (methyl methacrylate) (PMMA), where a micro-well and -channel were embedded to serve as a drug reservoir and diffusion barrier, respectively. On a channel plate (i.e., CP), a channel was filled with biocompatible polymer, polyethylene glycol (PEG) while a well of a well plate (i.e., WP), was filled with a find powder of a model drug, fluorescein. The length of the channels were varied to 1 mm, 4 mm and 8 mm, showing more sustained drug release as the channel length increased. By tailoring the length of the channels properly, therefore, a continuous drug release was possible with a single microchip which has smaller size, equipped with multiple pairs of drug wells and channels.

## Biomedical Robotics

### O5-1 초음파 프로브의 압력이 영상 선명도에 미치는 영향

김민태<sup>1</sup>, 정현철<sup>1</sup>, 신현수<sup>1</sup>, 전한웅<sup>1</sup>, 손재범<sup>1</sup>, 김지훈<sup>2</sup>, 조영호<sup>1</sup>, 김광기<sup>1</sup>

<sup>1</sup>국립암센터 융합기술연구부 의공학연구과

<sup>2</sup>서울대학교병원 영상의학과

An equipment to assess the effect of pressure of ultrasound probe on its image resolution was developed. This equipment is composed of four pressure sensors, a motor to provide vertical motion, and custom LabView software to obtain the probe pressure and ultrasound image synchronously. A subsequent pilot experiment with ATS phantom was performed with attached clinical ultrasound diagnoser. As the result, ultrasound image resolution was reduced with the increase of probe pressure. We expect that it is possible to utilize this result in the optimal control of automated ultrasound image acquisition. This study was supported by Seoul City grant (ST100011).

## Orthopedic and Rehabilitation Engineering

### O5-2 유착성관절낭염 환자의 바이오피드백 재활 치료를 위한 통증 모멘트 검출

이상기<sup>1</sup>, 김혜진<sup>1</sup>, 김지원<sup>1</sup>, 권유리<sup>1</sup>, 엄광문<sup>1</sup>, 이정현<sup>2</sup>, 이승현<sup>2</sup>, 김동휘<sup>3</sup>

<sup>1</sup>건국대학교 의학공학부

<sup>2</sup>창명제어기술(주)

<sup>3</sup>고려대학교 병원 재활의학과

The purpose this study is to detect pain of moment in patient with adhesive capsulitis for biofeedback rehabilitation. Shoulder moment during passive flexion was measured with torque sensor. Pain threshold was determined as the 90% of difference between estimated gravitational torque and the minimum torque at the maximal pain.

### O5-3 게임 콘텐츠를 이용한 근전도 기반의 무선 근 재활 시스템 개발

이영호<sup>1</sup>, 김강수<sup>1</sup>, 강복만<sup>1</sup>, 최흥호<sup>1</sup>, 문창수<sup>2</sup>, 문치웅<sup>1,2</sup>

<sup>1</sup>인제대학교 의용공학과

<sup>2</sup>KMG

<sup>3</sup>인제대학교 FIRST/UHRC

In this study, muscle training system was developed for effective rehabilitation treatment. This system consists of the electromyogram (EMG) acquisition module, the graphic user interface (GUI) system, and game contents of each channel mode. EMG signal were transmitted to GUI by the EMG acquisition module which was wireless communication system using Zigbee. The developed GUI can be used to control the direction in game operation using acquired EMG signals. The obtained data were analyzed using laboratory-developed software based on Microsoft Foundation Class (MFC) of Visual Studio 2008. The games were developed as each-channel mode for various exercises in rehabilitation. This system was to overcome the boredom and monotony in rehabilitation. We proposed the method which improves the patient's participation willingness and motivation in rehabilitation.

### O5-4 승마운동형 운동기구를 이용한 운동량 추정에 관한 연구

정경렬, 최준호, 김사엽, 박성빈, 전세웅<sup>1</sup>, 고건<sup>2</sup>, 손현목

한국생산기술연구원, <sup>1</sup>전자부품연구원, <sup>2</sup>유도스타자동차(주)

"Ridebot" has been developed for aiming at improving healthcare, an exercise training machine providing a

simplified horse riding motion. The purpose of this study was to estimate the physical activity reflecting user's physical characteristics using horseback riding simulator. The subjects consisted of 120 men and women. The test program consisted of circulation test of 1 minute per nine motions for 25 minutes riding wearing portable cardio pulmonary exercise testing analyzer. The physiological variables were HR and energy expenditure. There are significant differences in the motion of energy expenditure compared with resting state. The Pearson correlation coefficient are 0.919 ( $p < 0.001$ ) between motion and energy expenditure.

**O5-5 일차성 퇴행성 관절염 진행으로 인한 골 미세구조  
특성 변화 추적 관찰**

이주형<sup>1,2</sup>, 전경진<sup>1</sup>, 김한성<sup>2</sup>, 임도형<sup>1</sup>

<sup>1</sup>한국생산기술연구원 실버기술개발단

<sup>2</sup>연세대학교 보건과학대학 의공학과

The aim of this study was to study a pattern of the alterations of bone micro architectural characteristics induced by primary osteoarthritis (OA) over time, through longitudinal tracking the alterations using in-vivo micro-CT (Skyscan 1076, Belgium)





2011년도 제43회 대한의용생체공학회 춘계학술대회

## POSTERS I



KOSOMBE



P1-01 **초음파 수술기 handpiece의 수리비 절감 및 가동율 향상**

오주현<sup>1</sup>, 사은식<sup>1</sup>, 김종순<sup>1</sup>, 신동익<sup>1</sup>, 주세경<sup>1,2</sup>, 허수진<sup>1,2</sup>

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Ultrasonic surgical aspirator system is one of the main surgery equipment that is used to cut or coagulation the patient's tissue with ultrasound energy. Handpiece, a part of the ultrasonic surgical aspirator system, is a transducer which converts electrical energy to ultrasonic vibration. When the handpiece is damaged or out of order, the time and cost for repairing is generally long and high, respectively. In this paper, we present several cost-effective ways in repairing the handpiece. With the presented methods, the cost saving in repairing was about 130 million won and time for repairing was reduced from 221 days to 1 day.

P1-02 **진단 영상 의료기기의 낙하 위험 방지를 위한 안전관리**

최기철<sup>1</sup>, 진경원<sup>1</sup>, 김종순<sup>1</sup>, 신동익<sup>1</sup>, 주세경<sup>1,2</sup>, 허수진<sup>1,2</sup>

<sup>1</sup>서울아산병원 의공학과

<sup>2</sup>울산대학교 의과대학 의공학교실

There is a high risk of falls of the diagnostic imaging medical equipment since the weight of them is over 100kg in general. To prevent falls of the equipment, an additional protocol for checking the safety is necessary during safety management process. In this paper, we present guidelines of safety check to prevent falls, which includes the classification of the diagnostic imaging medical equipment and check points for each classified group.

P1-03 **누수 사고의 위험이 있는 의료기기의 안전관리**

윤희구<sup>1</sup>, 김승훈<sup>1</sup>, 김종순<sup>1</sup>, 신동익<sup>1</sup>, 주세경<sup>1,2</sup>, 허수진<sup>1,2</sup>

<sup>1</sup>서울아산병원 의공학과

<sup>2</sup>울산대학교 의과대학 의공학교실

In this paper, we present the activities performed in Asan Medical Center to prevent water leaks of medical equipment. Water leaks of medical equipment could cause severe problems such as electric shock and fire. To prevent these accidents, medical equipment which utilizes water for its operation requires activities for preventing water leaks. After analyzing the records of the water leak cases during 2007 to 2009, some complementary solutions for three medical

equipments were designed. The results showed that the water-leak accidents were reduced to 45% and there was no secondary accident.

P1-04 **식품의약품안전청 의료기기 허가심사를 위한 정보제공 구축에 관한 설문 조사**

공현중<sup>1</sup>, 서광석<sup>2</sup>, 안원식<sup>3</sup>

<sup>1</sup>서울대학교 의학연구원 의용생체공학연구소

<sup>2</sup>서울대학교 치의학대학원 치과마취과

<sup>3</sup>서울대학교 의과대학 마취통증의학과

It is true that we have problems in approval of medical device from Korea Food & Drug Administration (KFDA). Although there will be several causes of difficulties, one is a lack of information. The KFDA will try to build internet information services about relevant standards, and summary information of product approval. Prior to development of information service system, we carried out an explorative survey targeted to medical device manufacturers. Survey results provide that the information service will be helpful for device manufacturers to get approval from KFDA.

P1-05 **시멘트유지형과 나사유지형 임플란트의 임상학적 분석**

정재관, 이수옥, 차은중, 김경아

충북대학교 의과대학 의공학교실

Implant is a system water in the oral cavity of the patient period for the tooth harmonize in reappearance. Implant prosthesis writes a book, function of pronunciation and aesthetic appreciation must be being sufficient with general supplement and the same. But implant fixture becoming the osseous tissue and combination from the condition where the confrontation has become loss, shows a difference from the part which is intercourse. Namely, periodontal membrane do not exist to without being, in intercross a more consideration.

P1-06 **의공학 기술 전공분야별 인증기준 개발 연구**

최병철

춘해보건대학 의료공학과

Major Industry accrediting criteria of the major fields in biomedical engineering technology that represent major areas of human resources for the faculty of the configuration, you need to include at least a combination of course, subject to a minimum of a complete and has been presented and practiced skills. In this study, presented at the conference by Major Industry accrediting criteria of ABEEK for Biomedical Engineering Technology degree in technology and similar names were based on the process of certification.

## Biomedical Optics

### P1-07 동맥경화증 조기진단을 위한 자기기전력 SD-OCT 이미징 기술

구자성<sup>1</sup>, 이창호<sup>2</sup>, 김지현<sup>2</sup>, 오정환<sup>3</sup>

<sup>1</sup>부경대학교 메카트로닉스공학과

<sup>2</sup>경북대학교 전자전기컴퓨터공학부

<sup>3</sup>부경대학교 의공학과

We demonstrate a novel imaging modality, magneto-motive Optical Coherence Tomography (MM-OCT), to detect early stage of atherosclerosis. MM-OCT technique was used to detect magnetic nanoparticles taken up by macrophages as a marker of atherosclerotic vulnerable plaque mixed with phantom by an externally applied temporally oscillating high-strength magnetic field. Magnetic nanoparticles are directly used as molecular probes in OCT imaging. Our results indicate that MM-OCT is a candidate technique to identify macrophages and suggest that this new technique can be extended to become molecular specific MM-OCT imaging system.

### P1-08 치료용 양성자선의 상대깊이선량 측정을 위한 광섬유 체렌코프 센서의 특성분석

장경원, 문진수, 한기택, 유옥재, 서정기, 박장연, 이봉수

건국대학교 의료생명대학 의학공학부, 의공학 실용기술 연구소

In this study, we measured the intensities of Cerenkov light generated from a plastic optical fiber induced by proton beams to obtain the relative depth doses in a water-phantom. Additionally, we determined a spread-out Bragg-peak using a fiber-optic Cerenkov sensor and the results were compared with those of an ionization chamber.

### P1-09 고 분해능 광섬유 방사선량계를 이용한 선량 보강영역에서의 심부선량 백분율 및 피부선량 측정

유옥재<sup>1</sup>, 장경원<sup>1</sup>, 서정기<sup>1</sup>, 문진수<sup>1</sup>, 한기택<sup>1</sup>, 박병기<sup>2</sup>, 김신<sup>3</sup>, 이봉수<sup>1</sup>

<sup>1</sup>건국대학교 의료생명대학 의학공학부

<sup>2</sup>순천향대학교 공과대학 에너지환경공학과

<sup>3</sup>제주대학교 공과대학 에너지공학과

In this study, we fabricated a fiber-optic dosimeter using an organic scintillator with 0.5 mm diameter for photon-beam therapy dosimetry. Using this fiber-optic dosimeter, skin dose and percentage depth dose in the build-up region according to the depths of a solid-water phantom are measured with 6 and 15 MV photon beam energy with field sizes of 10 x 10 and 20 x 20 cm<sup>2</sup>, respectively.

### P1-10 치료용 15 MV 광자선을 이용한 1차원 광섬유 팬텀 선량계의 성능평가

문진수, 장경원, 유옥재, 서정기, 한기택, 박장연, 이봉수

건국대학교 의료생명대학 의학공학부, 의공학 실용기술 연구소

In this study, we fabricated a one-dimensional fiber-optic phantom dosimeter, which consists of 9 fiber-optic radiation sensors (FORSs) for measuring surface dose and relative depth doses in a solid water phantom with therapeutic photon beams. As a light-measuring device, a charge-coupled device was used and connected to each FORS with 20 m-length of plastic optical fiber. Using this dosimetry system, we measured surface dose and relative depth doses of 15 MV photon beam and compared these results with those of EBT films and ionization chamber.

### P1-11 유한 요소법을 이용한 생체 조직 내 광원의 온도 분포 분석 연구

윤진희, 윤종인

대구가톨릭대학교 의공학과

Light-based treatment of tissue can be used for a variety of applications in medicine including tissue ablation, biostimulation and low-level laser therapy. Since knowledge of the light and thermal distribution in tissue depends on the wavelength, power density, duration of exposure, and optical and thermal properties of tissue, many investigations have been performed to evaluate optical and thermal events during and after light exposure. In this study, the numerical analysis of heat transfer versus penetration depth and radius in tissue were performed with different light sources using a Finite element method. The results showed that the amount of heat generation over the depth in tissue at  $\lambda = 660$  nm laser diodes (LD) was greater than the same wavelength with light emitting diode (LED). When comparing  $\lambda = 660$  nm LD and  $\lambda = 830$  nm LD, the light penetration depth in tissue at  $\lambda = 830$  nm was deeper than that of  $\lambda = 660$  nm. This study may help lend insight into thermal events occurring inside tissue layers during light therapy.

### P1-12 복강경하 위 절제술에서의 간 견인을 위한 장치의 개발

정현철<sup>1</sup>, 김광기<sup>1</sup>, 김영우<sup>2</sup>

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<sup>2</sup>국립암센터 위암센터

Laparoscopic gastrectomy procedure is frequently obstructed by liver, which obscures the field of vision, and which may be damaged by surgical devices. The damaged liver may cause a complication which is not directly related to the symptom. Therefore it is important that surgeons secure enough visual and physical room for the operation. In this paper, we developed a device that can be inserted through a trocar, retract liver and can be fixed externally to decrease risks in laparoscopic gastrectomy. This work was supported by a grant from the National Cancer Center (1110610).

### P1-13 협력제어를 통한 수술 보조용 로봇 개발에 관한 기초연구

정우석<sup>1</sup>, 권석령<sup>1</sup>, 신민기<sup>1</sup>, 이치원<sup>1</sup>, 조규진<sup>1</sup>, 김성완<sup>2</sup>

<sup>1</sup>서울대학교 공과대학

<sup>2</sup>서울대학교 의과대학

Conventional surgical robots have been mainly developed for major surgery and there have been demands for minor surgical devices. In this study, surgical assistance device with shared control system which consists of a robot manipulator together with end-effector and force sensor is developed. The control algorithm is mainly based on the impedance control and admittance control. With the shared control system, a surgeon can cooperate with the robot and judge the situation and impose repetitive jobs to the robot. This system could relieve fatigue of the surgeon in various minor surgeries.

### P1-14 폐쇄 회로형 지혈 클립 및 장착 장치 개발

이상봉<sup>1</sup>, 이준화<sup>1</sup>, 조성연<sup>2</sup>, 박상재<sup>2</sup>, 김광기<sup>1</sup>

<sup>1</sup>국립암센터 융합기술연구부 의공학연구과

<sup>2</sup>국립암센터 간암센터

A closed loop-shaped hemostatic clip and its applicator have been being developed for minimally invasive cancer surgery. Conventional U-shaped clips are often used to stop bleeding during laparoscopic surgery. However, surgeons

find it difficult to apply conventional U-shaped clips to certain surgical procedures such as partial clamping of a blood vessel. Also, U-shaped clips cannot be easily applied when a clip applicator is positioned orthogonal to the cross section of a blood vessel to be clamped. These issues can be resolved by changing the shape of the clip from the open U-shape to a closed loop configuration. Based on this idea, we invented a closed loop-shaped hemostatic clip and its dedicated applicator. The closed loop-shaped clip is expected to overcome aforementioned limitations of the conventional U-shaped one. This work was supported by a grant from the National Cancer Center (1010260).

### P1-15 X선 디텍터 자동화를 위한 모터 제어장치

김태곤<sup>1</sup>, 김영표<sup>1</sup>, 천민우<sup>2</sup>, 이호식<sup>2</sup>, 박용필<sup>2</sup>

<sup>1</sup>동신대학교 대학원 전기전자공학과

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Recently, in the image acquisition field using X-ray equipment, the use of digital radiography which is useful in the acquisition time reduction and transfer of images and is possible to have the dose reduction has expanded. With the structure using one detector, this DR device has disadvantages in that it needs structural changes unlike existing X-ray and the detector should be moved to the desired position depending on the shooting location. Therefore, in this study, using motor the automatic control system of 3-axis which are up and down, left and right, rotational of detector where having the most movement in DR was designed and produced and its performance was evaluated.

## Medical Imaging

### P1-16 종축 확장을 위한 PET 블록 검출기의 아날로그 멀티플렉싱 구현

윤현석<sup>1,2</sup>, 고근배<sup>1,2</sup>, 권순일<sup>1,3</sup>, 이또우 미끼꼬<sup>1,4</sup>, 이동수<sup>1,3,4</sup>, 홍성종<sup>5</sup>, 이재성<sup>12,3,4</sup>

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<sup>3</sup>방사선응용생명과학 협동과정, <sup>4</sup>방사선의학 연구소,

<sup>5</sup>을지대학교 방사선학과

A high-resolution preclinical positron emission tomography (PET) system consists of position sensitive block detectors is under development. Extension of axial length without adding extra data acquisition system is possible with analog signal multiplexing technique. The multiplexing was validated by reading two block detectors with single data acquisition board (DAQ). With multiplexing, flood image of two detector blocks was obtained at once. There was some degradation in spatial resolution compared to the one without multiplexing.

### P1-17 고해상도 PET를 위한 다중 양극 광전자증배관 (H10966) 블록 검출기의 성능 평가

고근배, 이또우 미끼꼬, 이재성

서울대학교 핵의학과

Hamamatsu H10966 is new type of flat panel multi-anode PMTs which have 8x8 multianode. This PMT is similar to H8500 but the number of stage is difference (8 stages for H10966, 12 stages for H8500). To evaluate the performance of the PMT for high resolution PET application, we development block detector module consists of 29x29 LGSO crystals (1.5x1.5x7.0 mm<sup>3</sup>). The detector module mounted on resistive charge division network (RCN) for multiplexing 64 channel anode signals into four analog signals. A LGSO detector composed of 4x4x10 mm<sup>3</sup> single LYSO crystal and a fast PMT (Hamamatsu R9800) was used as the reference detector. The 29x29 1.5mm crystal was clearly separated in the flood image. The energy resolution of gr 31.3% and the total coincidence timing resolution was 938ps.

### P1-18 Time-of-Flight PET을 위한 Fast Photomultiplier의 성능 측정

이진표, 이또우 미끼꼬, 이재성

서울대학교 원자핵공학과, 서울대학교 핵의학과

Additional time-of-flight (TOF) information in positron

emission tomography (PET) imaging leads to improve the image quality, because the TOF information allows localizing three dimensional annihilation positions. For the accurate positioning, a precise time resolution is one of the most important characteristics in TOF-PET system. The aims of this study are to find out the optimal setup for timing measurements and to evaluate timing performance of fast PMT (Hamamatsu R9800) with LYSO scintillator for TOF-PET. The optimal time resolution of 198 ps was obtained using CFD with 1.0 ns time delay. Energy resolution at 511 keV was 10.8 %. Additionally, the experiments related to the positioning uncertainty were performed and positioning resolution was estimated to be 4.50 cm.

### P1-19 반응깊이 및 시간정보검출용 어레이타입 SiPM PET 블록검출기 개발

권순일<sup>1</sup>, 이또우 미끼꼬<sup>1</sup>, 윤현석<sup>1</sup>, 고근배<sup>1</sup>, 홍성종<sup>2</sup>, 이재성<sup>1</sup>

<sup>1</sup>서울대학교 핵의학과

<sup>2</sup>을지대학교 방사선학과

Silicon photomultiplier (SiPM) is a promising device for the development of positron emission tomography (PET) scanner, such as depth of interaction (DOI) based PET, time of flight PET, and simultaneous PET/MRI. The SiPM has a quite small sensitivity area with tiny package. Therefore, the compact and cost-effective circuits are required for using SiPMs. In this study, two compact circuits for continuous-DOI detector and timing improved block detector for PET, which were in developing, were introduced. Basic performances were measured with these boards using four 4 x 4 array-type SiPMs and 2 x 2 x 28 mm<sup>3</sup> LYSO crystals.

### P1-20 블록 검출기 사이 틈새 보정 방법들의 비교 연구

손정아<sup>1</sup>, 이재성<sup>1</sup>, 김수미<sup>1</sup>, 이동수<sup>1</sup>

<sup>1</sup>서울대학교 핵의학교실

Gaps between the block detectors in small-diameter PET scanners cause significant loss of data when obtaining sinogram. Gap-filling with a DCT domain filter, total variation method, and mBSREM are the methods developed to reduce the effects of gaps. In this study, we compared the performance of 3 gap compensation methods. TV-ART has produced the best result in terms of percent error and image quality for noiseless Shepp-Logan (SL) phantom data. However, for the noisy data, BSREM and TV-EM have yielded the most acceptable results.

P1-21 **알츠하이머병에 적용된 매니폴드 러닝 기법의 비교**

박현진

가천의과학대학교 의공학과

Manifold learning methods are often used to differentiate clusters based on collection of pair-wise distances. Here we adopted bending energy of pair-wise image registration as the pair-wise distance. We compared two popular manifold learning methods; Multidimensional scaling (MDS) and ISOMAP. ISOMAP is considered as a more advanced version of MDS with robust performance. Applying both MDS and ISOMAP to collection of normal control and Alzheimer's disease (AD) scans yielded separable clusters between two groups. ISOMAP was shown to better differentiate between two clusters.

P1-22 **경두개 자기자극 내비게이션 시스템을 위한 3차원 탈라이라크 좌표 시스템**안효진<sup>1</sup>, 안세종<sup>1</sup>, 김종우<sup>1</sup>, 윤세진<sup>2</sup>, 정성택<sup>1</sup><sup>1</sup>한국산업기술대학교 컴퓨터 공학과<sup>2</sup>㈜씨알테크놀로지

Transcranial magnetic stimulation navigation system provides stimulation and the position of stimulation to 3D brain images that need promotion of brain function and rehabilitation through magnetic stimulation, not electric stimulation as non-invasive method painless. It is applied to diverse clinical diseases, for example, stroke, depression, Parkinson's disease. According to this application, it is important that the accuracy of the position and the direction stimulated to brain. This paper suggests a program to provide talairach coordinate on 2D MR image and to use brain study usefully by mapping accurate position of stimulation on 3D area considering individual anatomic position.

P1-23 **초음파 캐비테이션 영역을 통과하는 간섭파의 조사조건에 따른 감쇠량 비교**노시철<sup>1</sup>, 김주영<sup>2</sup>, 김진수<sup>2</sup>, 강정훈<sup>2</sup>, 최흥호<sup>2</sup><sup>1</sup>한국국제대학교 방사선학과<sup>2</sup>인제대학교 의공학과

In this study, as a fundamental research for the evaluation of cavitation yield, the acoustic characteristics of the bubble cloud were analyzed by measuring the attenuation in the bubble cloud. First, we cause cavitation using a concave-type single ultrasonic transducer. Subsequently, we transmit the ultrasound beam across the center of the bubble cloud. Under all sonication conditions, the attenuation was

decreased with an excellent correlation coefficient (0.7197, 0.8544, 0.8469, and 0.7795) in proportion to the rise in sonication intensity. On the basis of these results, we consider that this correlation is a very useful for the cavitation yield evaluation.

P1-24 **고령층에서의 the scaphotrapezio-trapezoidal (STT) joint 움직임 분석**박찬수<sup>1</sup>, 김광기<sup>1</sup>, 김유신<sup>1</sup>, 백구현<sup>2</sup>, 이상림<sup>3</sup><sup>1</sup>국립암센터 융합기술연구부 의공학연구과<sup>2</sup>서울대학교 의과대학 정형외과 교실<sup>3</sup>인제대 부속 상계 백병원

This study aims to analyze the motion of the scaphotrapezio-trapezoidal (STT) joint by using three-dimensional modeling and Wrist motion fixation device. We acquired CT image of Normal right wrists (6 subjects). Segmentation and three-dimensional modeling of bones from CT images was performed using the Analyze software. Distance and angle among centroids of the scaphoid-trapezium-trapezoid were calculated to analyze the motion by using MATLAB program. The result of this study indicate the trapezoid and trapezium are tightly linked and the scaphoid major role of STT joint motion.

P1-25 **MPEG-2 방식을 사용한 볼륨데이터 압축**

오홍식, 김인영, 김선일

한양대학교 의공생체공학과

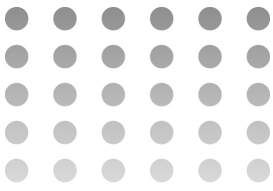
Medical imaging applications which using 3D/4D volumetric data produce a large set of images, each images has a high correlation in temporal and spatial factors. Thus a video compression technique, which like a MPEG and Motion-JPEG, is useful to reduce storage spaces. This study presents a MPEG-2 baseline profile based volumetric data compression for 3D/4D medical images. Due to strong similarity each successive slice in volumetric data set, it is one of useful methods which can be suitable for 3D/4D data compression.

P1-26 **디지털 래디오그래피 디텍터 성능 분석을 위한 캐스케이드 툴킷 개발**

윤승만, 윤한빈, 한종철, 장선영, 조옥라, 박하령, 감수화, 김호경

부산대학교 기계공학부

We have developed a graphical toolkit to analyze the theoretical performance of digital radiography (DR)



detectors by using MATLAB<sup>®</sup> GUIDE and SIMULINK toolbox. A serial cascaded linear-system theory has been employed to model to describe the signal and noise propagations in detector. From the modeling, theoretical detective quantum efficiency (DQE) has been calculated and verified by measured DQE data. The developed SIMULINK toolkit will be very useful to the DR detector users and the toolkit helps DR developers find optimal DR detector design parameters.

**P1-27 A basic study for using BEAMnrc Monte Carlo code for photon beam treatment head simulations**

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<sup>3</sup>Department of Medical and Biological Engineering,  
Kyungpook National University

In this paper, BEAMnrc Monte Carlo code is used for a basic modeling of photon beam treatment head. As Monte Carlo method which is the most suitable in the domain of medical statistics, using the code for photon transport simulation can be reasonable enough. To control the route of photons, various components are needed with different materials and that can be simply done by the BEAMnrc. By showing the preview image of the accelerator with components modules that the user selected, BEAMnrc can give the user a big help to simulate electron-photon transport experiments effectively.

**P1-28 분리 마스크를 이용한 자동 체지방 측정 방법**

김영재<sup>1</sup>, 김유신<sup>1</sup>, 조유창<sup>1</sup>, 최승홍<sup>2</sup>, 김광기<sup>1</sup>

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<sup>2</sup>서울대학교병원 영상학과

In recent years, the number of obese in Korea has annually been raising up affected by the economic improvement, environmental factors and the change in life style. It is getting to be important to prevent and diagnose the obesity and the quantitative measurement of body fat has become an important indicator for that. In this study, we have proposed the automated fat assessment using separation mask on CT-volume data. We have calculated the correlation between the manual assessment and the automated assessment. As a result, two methods are significantly correlated by 0.73.

**P1-29 대동맥 영역 분할을 위한 허프 변환의 적용**

심 훈<sup>1</sup>, 이승환<sup>1</sup>, 홍준희<sup>1</sup>, 하종원<sup>2</sup>, 윤영로<sup>1</sup>

<sup>1</sup>연세대학교 대학원 의공학과

<sup>2</sup>연세대학교 의과대학 심장내과

Multi-detector Computed Tomography (MDCT) is useful device to detect abnormal state of heart using contrast medium. An aortic aneurysm is diagnosed with observation of extended artery region. It is important to measure the diameter of artery from images. In this study, we applied Hough transform to recognize the region of aorta. We demonstrated our method is possible to detect circle-shaped artery region from image.

**P1-30 나노섬유 웹을 이용한 압정전용량성 센서와 걸음자세 측정**

백승현<sup>1</sup>, 김태의<sup>1</sup>, 위현<sup>1</sup>, 윤선<sup>2</sup>, 오동인<sup>1</sup>, 김갑진<sup>2</sup>, 우응제<sup>1</sup>

<sup>1</sup>경희대학교 생체의공학과, 임피던스영상 신기술 연구센터

<sup>2</sup>경희대학교 고분자섬유신소재과

A ubiquitous health care system requires long-term monitoring of life pattern or movement in their daily living environments. Compared with conventional sensors for health management service, it is more suitable to adopt a wearable sensor network using textile sensors due to flexibility, durability and washability. In this study, we developed the piezo-capacitance pressure sensor based on electrospun nano-fiber webs. We made custom shoe insoles to detect weight distribution on the foot during walking. From the results, we can detect speed and weight distribution. It can be useful for correction of posture and gait.

**P1-31 유방 초음파 영상에서 종괴경계를 이용한 컴퓨터 보조 진단 (CADx)법**

유동훈, 이수열

한국전자통신연구원 유헬스연구팀

Breast cancer diagnosis on ultrasound images significantly contributes in the area of early detection. Computer Aided Diagnosis (CADx) helps radiologist to decide the malignancy of lesions. We adopted three features to represent the characteristics of lesion, DWR (depth to width ratio), modified compactness, and newly proposed border feature is used to represent characteristics of lesion. Using these features, we calculate the malignancy score using neural network.



#### P1-32 MRI 데이터를 이용한 유방 변형의 질량-스프링 모델링

박하령<sup>1</sup>, 윤한빈<sup>1</sup>, 김종효<sup>2</sup>, 김호경<sup>1</sup>

<sup>1</sup>부산대학교 기계공학부

<sup>2</sup>서울대학교 의과대학 영상의학과

To diagnose breast cancer, various imaging modalities, such as digital mammography, ultrasound imaging, magnetic resonance imaging (MRI), are used. Each modality has its own unique pros and cons. Therefore, if we could combine those images into a single image, we might utilize the advantages of each imaging modality. However, registration of breast images obtained from various modalities is challenging because each modality has different degree of breast deformation. In this study, we investigated whether the degree of deformation could be adjusted. We performed deformation of MRI breast data using mass-spring system.

was observed. Therefore, preprocessing without properly updated offset and gain images would underestimate the DQE when performing quality control of a detector in the field. This study provides a motivation that the periodic monitoring of the image-quality degradation is of great importance for the long-term and healthy use of digital x-ray imaging detectors.

#### P1-35 X-선 영상 센서 적용을 위한 상변환에 따른 Lead Oxide의 전기적 특성 및 구조적 특성 연구

노성진<sup>1</sup>, 이상훈<sup>2</sup>, 박혜진<sup>2</sup>, 김대국<sup>1</sup>, 박지균<sup>3</sup>, 조성호<sup>4</sup>, 남상희<sup>1,5</sup>

<sup>1</sup>인제대학교 의용공학과

<sup>2</sup>인제대학교 의료영상과학대학원

<sup>3</sup>한국국제대학교

<sup>4</sup>이화여자대학교

<sup>5</sup>인제대학교 의료영상연구소

Recently, many studies about digital x-ray detector are in progress. There are many studies about x-ray conversion material such as a-Se, a-Si and CdTe, that is used in direct conversion material for digital radiography. In this material, PbO (Lead( II ) Oxide) is promising material for DR because of PbO's stable characteristics. So, we studies about digital x-ray detector based PbO in this paper. Through this study we optimized screen printing method based on Pbo x-ray detector and through the measurement of electrical properties we suggest that  $\alpha$  -PbO is promising material for direct conversion method x-ray detector. Although X-ray sensitivity was increased using the  $\alpha$  -PbO this sensitivity was insufficient to apply in existing TFT capacity. Therefore, we think that the study about increasing X-ray sensitivity will be performed.

#### P1-33 이중에너지 영상에서의 모션아티팩트 보정을 위한 영상정합 방법에 관한 연구

윤한빈, 한종철, 김호경

부산대학교 기계공학부

Dual-energy subtraction in x-ray radiography is useful technique to eliminate the non-interested components such as hard bones in chest radiography. However, conventional double shot dual energy imaging technique has inherent artifact which is originated from patient motion. In this study, image registration technique is adapted to dual energy subtraction by using mutual information and the normalized cross correlation is used as of figure of merit. We acquired successful initial result reducing motion artifact in dual-energy imaging.

#### P1-34 대면적 CMOS 디텍터의 누적 선량에 따른 신호 및 잡음 특성 변화

한종철, 윤승만, 임창휘, 조옥라, 김호경

부산대학교 기계공학부

We have experimentally investigated the long-term stability of the signal and noise characteristics as a function of the accumulated dose at the entrance surface of the detector. The aging effect in image quality has been reported in terms of modulation transfer function (MTF), noise-power spectrum (NPS) and DQE (detective quantum efficiency). While MTF was almost insensitive to the total dose, degradation in NPS

## Medical Nano and Microtechnology

### P1-36 수소결합력 측정을 위한 마이크로 유체 시스템에서의 유전영동집게

박인수<sup>1</sup>, 곽태준<sup>1</sup>, 최범준<sup>1</sup>, 이재우<sup>1</sup>, 엄길호<sup>2</sup>, 권태윤<sup>1</sup>, 윤대성<sup>1</sup>, 이상우<sup>1</sup>

<sup>1</sup>연세대학교 의공학과

<sup>2</sup>고려대학교 기계공학과

We present a novel 'dielectrophoretic force micro-copy' technique that can be used to characterize chemical interactions by forcing a micro-particle inside a micro-fluidic device to move away from a functionalized surface, resulting in breaking of the interactions between the molecules on the surface and the bead. We present detailed characterization results, validated by a simulation based model, and show that the technique can be used to measure forces of interaction between molecules under various experimental conditions.

### P1-37 미세 마이크로 패턴으로 구성된 3D 곡면 마이크로 구조의 제작

류지희<sup>1,2</sup>, 이상훈<sup>2</sup>

<sup>1</sup>고려대학교 일반대학원 바이오 마이크로 시스템 기술 협동과정

<sup>2</sup>고려대학교 보건과학대학 생체 의공학과

In this paper, we have developed a novel and simple method for the micro fabrication of arrays of small patterned concave chambers with different diameters and curvatures by used of a small patterned thin ( $\sim 10 \sim 20 \mu\text{m}$ ) poly (dimethylsiloxane) (PDMS) membrane, SU-8 shadow mask, and compressed air. It is suggested that our system will be useful for improvements in various bio-MEMES (Microelectrode mechanical system) applications, including cell patterning, stem cell differentiation, and microlens.

### P1-38 환경 변화에 따른 무선 전력 전송 회로의 임피던스 및 공진 주파수 변화

유순기<sup>1</sup>, 김소희<sup>1,2</sup>

<sup>1</sup>GIST 기전공학부

<sup>2</sup>GIST 의료시스템공학 학제전공

In biomedical implant devices, researchers have used wireless power transmission system using inductive coupling. This system requires the transmitter and receiver circuit to operate at the same frequency. But resonant frequency varies according to temperature change and physiological environment when the device is implanted or close to conductive medium. In order to see how the

characteristics of the coil used in resonant circuit change, we attached or inserted the coil in the agarose gel, which is a conductive material. We measured the characteristics of the equivalent circuit of the coil by checking the behavior of impedance and resonant frequency. From this observation the value of capacitance to recover the resonant frequency from shifted one was found.

### P1-39 초음파를 이용한 Pbl<sub>2</sub> 합성과 그에 따른 Photoconductor Sensor 제작 및 전기적 특성 비교 분석

이윤진<sup>1</sup>, 신정욱<sup>2</sup>, 박근우<sup>1</sup>, 김지나<sup>1</sup>, 권준환<sup>2</sup>, 박성광<sup>3</sup>, 남상희<sup>2,4</sup>

<sup>1</sup>인제대학교 의료영상과학

<sup>2</sup>인제대학교 의공학과

<sup>3</sup>부산 백병원

<sup>4</sup>인제대학교 의료영상연구소

In this study, has been widely used for the direct conversion of amorphous selenium based Digital X-ray Detector with a higher electrical signals to produce a commercially Photoconductor Sensor Pbl<sub>2</sub> and compared the characteristics of the synthesized Pbl<sub>2</sub>. Pbl<sub>2</sub> and synthesized commercially Pbl<sub>2</sub> each paste made by Binder and Mixing. Screen Printing method is through a conductive ITO coated Photoconductor Sensor for glass was fabricated. Magnetron sputtering system by using the upper electrode was deposited. Photoconductor Sensor manufactured by the I-V test Dark current, Sensitivity, SNR was evaluated. Dark current is a low Pbl<sub>2</sub> synthesized, commercially available Pbl<sub>2</sub> Sensitivity and SNR higher than the results.

### P1-40 전사 수준에서의 AIMP2 돌연변이를 정량화하기 위한 모세관 전기영동과 레이저 유발 형광 검출 장치

박상윤<sup>1</sup>, 정태우<sup>2</sup>, 김성훈<sup>2</sup>, 김희찬<sup>3</sup>, 천홍구<sup>4</sup>

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Quantification method for ARS-interacting multi-functional protein 2 (AIMP2/p38) and its variant AIMP2-DX2 at the transcription level is presented. mRNAs in the cell lysate were analyzed using fluorescence tagged AIMP2 specific and AIMP2-DX2 specific ssRNA. After the conjugation, RNA mixture was separated and quantified by microchip-based capillary electrophoresis and laser-induced fluorescence (LIF) detection. The limit of detection under 1 nM was achieved, sufficient for quantification without PCR amplification.

## Neural Engineering

### P1-41 정보 이론 기반의 시간 지연 분석을 이용한 Lennox-Gastaut Syndrome 환자의 간질 발생 부위 추적

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To assist the precise localization of ictal onset zones in epilepsy surgery, researchers have developed various computational electroencephalogram (EEG) analysis methods. However, most of the previous studies focused only on focal epilepsy. In the present study, we used intracranial EEG (iEEG) recordings acquired from patients with Lennox-Gastaut syndrome (LGS), which is a type of secondary generalized pediatric epilepsy. To estimate the ictal onset zones, we calculated the time delay between iEEG channels. The results of time delay analysis corresponded well with the surgical resection areas, suggesting that the time delay analysis can provide useful information in epilepsy surgery of LGS patients.

### P1-42 안정 상태 시각 유발 전위 기반의 뇌-컴퓨터 접속을 위한 새로운 이중-주파수 자극 제시 방법

황한정<sup>1,2</sup>, 임정환<sup>1,2</sup>, 이상우<sup>1</sup>, 임창환<sup>2</sup>

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The aim of this study was to generate more visual stimuli with limited numbers of stimulating frequencies in steady state visual evoked potential (SSVEP)-based brain-computer interface (BCI) system. To this end, a new dual-frequency stimulation method was devised by modifying the conventional checkerboard pattern stimuli and consequently ten different visual stimuli could be generated from the combination of only four different frequencies. EEG signals were recorded while subjects were gazing at the visual stimuli, and then the power spectrum analysis was applied to the EEG data to observe SSVEP responses. From the analysis results, it was confirmed that each visual stimulus could evoke a distinct SSVEP peak, demonstrating that the suggested dual-frequency stimulation method can be an effective way to increase the number of visual stimuli in SSVEP-based BCI systems.

### P1-43 폐쇄성수면무호흡 특성에 따른 뇌파와 심전도분석

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<sup>4</sup>동산의료원 신경과

<sup>5</sup>계명대 의공학과

<sup>6</sup>동산의료원 심장내과

To investigate the dynamics of the synchronization between heart rate (HR) and sleep electroencephalogram (EEG) power spectra by characteristics of obstructive sleep apnea (OSA), R wave detection in electrocardiogram (ECG) recordings, as well as heart rate analysis was calculated during 3 min. Period amplitude analysis was applied for R-R interval (RRI) analysis, and fast Fourier transformation (FFT) was applied to perform by characteristics of obstructive sleep apnea. Patients with server OSAS presented persistently lower frequency when compared to patient with apnea state. We expect that the result of this research will apply to discovery of mechanisms of the relationship between ECG and EEG.

### P1-44 시상 뇌졸중 환자의 이학적 검사 양상 분석

이인희<sup>1</sup>, 서석태<sup>2</sup>, 김민수<sup>2</sup>, 손창식<sup>3</sup>, 박희준<sup>4</sup>, 구정훈<sup>4</sup>,  
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The purpose of this paper is to investigate the result pattern and verify the usefulness of somatic sensory test for thalamic post-stroke patients. The Leeds Assessment of Neuropathic Symptoms and Signs (LANSS) is used to evaluate the pain scale of patients, and various somatic sensory tests are performed to the patients. To evaluate the usefulness of the somatic sensory tests, statistical analysis is applied to the test results based on SPSS with  $p < 0.05$ .

### P1-45 안정상태 시각유발전위에 기반한 QWERTY- style Mental Typewriter 구현

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In the present study, we introduce a new type of mental typewriter based on steady state visual evoked potential (SSVEP). Thirty LEDs were arranged in the order of a

QWERTY keyboard, and each LED was flickered with different frequencies. EEG signals were acquired while three subjects were focusing on each LED. SSVEP power for each LED was calculated using power spectrum analysis and classification accuracy was estimated based on the SSVEP power. The mean classification accuracy was 78.35% (ITR: 18.6 bit/min), demonstrating the possibility of implementing a QWERTY-style mental typewriter.

**P1-46 3차원 신경모델링에 기반한 extracephalic 전극을 사용하는 경두개직류자극의 안전성 및 효율 검증**

박지혜<sup>1,2</sup>, 심미선<sup>2</sup>, 임창환<sup>2</sup>

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<sup>2</sup>한양대학교 생체공학과

In this paper, we analyzed a transcranial direct current stimulation (tDCS) system with an extracephalic reference electrode, in order to validate the safety and efficiency of using an extracephalic reference electrode. Current density distribution in a 3D human body model was evaluated using 3D finite element method (FEM). Simulation results demonstrated that tDCS with an extracephalic reference electrode does not stimulate spinal cord and can stimulate targeted brain areas more accurately than the conventional tDCS systems.

**P1-47 얼굴 감정 인식 과제 중 정신분열병 환자의 증상 척도와 뇌의 활성도의 상관성 연구**

김도원<sup>1,3,4</sup>, 이승환<sup>2,3</sup>, 임창환<sup>4</sup>

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In this study, we aimed to investigate if clinical symptom scores correlate with source activation of each brain voxel to explain the impaired face processing of schizophrenia patients. The source activations were estimated using sLORETA focusing on the major event-related potential components (P100, N170, N250), which are known to participate on face perception and emotion recognition. The results show that the average source activity of various ERP components associated with facial emotional processing correlated with symptom severity, thereby suggesting that these results might be used as biological markers for the evaluation of schizophrenia patients.

**P1-48 A basic experiment to develop a robot controlled by EOG signal with Bluetooth**

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In this study, a basic experiment to develop a robot controlled by EOG signals with Bluetooth is presented. Electrooculography (EOG) is a technique for measuring the resting potential of the retina. The main applications are in ophthalmological diagnosis and in recording eye movements. The EOG signals were detected and recorded by a professional physiological signal detection device. The recorded signals will be processed by a LabVIEW program and transmit to the robot by Bluetooth. According to the results, develop a robot controlled using EOG signal is feasible.

**P1-49 뇌혈류소리 청취가 만트라 명상과 일반 명상의 뇌파변화에 미치는 영향**

김현중, 성민규, 장래혁, 안승찬

한국뇌과학연구원

In this study, the quantitative effect of the meditation methods with auditory stimuli was analyzed using listening to the sound of brain blood flow that has binaural beat characteristic. Our results show that the sound of brain blood flow can influence the brain wave. Theta wave, which influences creativity and long-term memory, can be measured under the mantra meditation condition. Alpha and SMR wave, which influence relaxation and concentration, can be measured under normal meditation condition.

**P1-50 원숭이 M1 신경 영역 신호에서 단일/다중 손가락 움직임 간 상관성 분석**

임선주, 유경진, 신현출

송실대학교 전자공학과

We study neural correlations between single finger movements and multi-finger movements using M1 neural activities. Data was recorded from 115 neurons in monkey's M1 motor cortex during 10 single finger and 6 multi finger movements. We divided 2.0 seconds data into three

sections, that is, before and during, after finger movements for comparison with correlation between single and multi finger movement in each of section. The results of the study indicate the existence of clear neural correlations between single and related multi-finger movements.

## Systems Biology, Physiological modeling

### P1-51 산소용해제를 사용한 이식용 인공폐 설계

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<sup>2</sup>충북대학교 의학과

Recently, there are many in-vivo animal evaluations of implantable artificial lung. In these studies, O<sub>2</sub> transferring rate was about 200 ml/min. But there are some problems. First, to supply enough O<sub>2</sub> demands, implantable artificial lung equipment should have about 100 m<sup>2</sup> exchange surface of lung. Second, when using high resistance equipment, anticoagulation agent is inevitable. To solve these problems, we propose an implantable artificial lung with oxygen solvent mediator. To prove its feasibility, we verify by experiments whether oxygen solvent mediator could deliver O<sub>2</sub> to blood. In our experiments, oxygen solvent mediator can deliver O<sub>2</sub> to blood successfully. We concluded that an implantable artificial lung can be design with oxygen solvent mediator.

### P1-52 초음파 가열 성능 평가를 위한 실시간 열 분포 측정 시스템 개발

김진수<sup>1</sup>, 노시철<sup>2</sup>, 김주영<sup>1</sup>, 강정훈<sup>1</sup>, 최흥호<sup>1</sup>

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<sup>2</sup>한국국제대학교 방사선학과

Ultrasound application cases have increased, because ultrasound has both features increasing temperature in the tissue and noninvasive characteristics. However, rise in temperature is non-linear and invisibly checked hard. Therefore, in this study, system for monitoring changes of temperature by irradiating ultrasound was manufactured, and heating evaluation for that system was performed. This irradiation time depending on the degree of change of temperature by the heating of each section was identified by displaying different colors, and ultrasound evaluation of the thermal characteristics could be shown that representation. The suggested system was considered as the useful data of ultrasound heating evaluation later.

### P1-53 성대결절이 전기성문도의 spectral tilt에 미치는 영향

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동아대학교 의과대학 의공학교실

Professional voice user increased, so interests about voice

quality and voice disorder are increased. Voice disorder is a condition of abnormal pitch, intensity or voice quality by trouble of respiratory, phonatory, resonatory and articulatory organs. Especially, vibration pattern of vocal cord affects pitch, intensity and voice quality. Vibration of vocal cord could be recorded conveniently with electroglottography without any constraints of time and place. In this study, we compare normal and abnormal subject by spectral tilt of difference between low and high frequency range.

## ***U-Health, eHealth Technology***

### **P1-54 Software for the treatment of Cerebral Palsy patients**

Fakhira Anwar, Jae-Keun Jang, Seung-Hun Park  
Department of Biomedical Engineering, Kyung Hee University, South Korea

The paper investigates the Software developed for the treatment of Cerebral Palsy patients. It is a comprehensive tool to cater to all the major perceptual, cognitive, coordination and communication disabilities which are an aftereffect of damage to motor areas in the brain, controlling movement or posture. After conducting surveys at various rehabilitation centers for these patients, four main personas and deduced key usability requirements on the basis of these personas were formed. Moreover, the contextual task analysis helped us design enhanced interactive activities aimed to reduce the dependency of patients on other people. The Software was deployed and tested at an institution for mentally impaired children, and the posttest results are discussed later in the paper.

### **P1-55 Design and implementation of smart card based wellness system**

Zulqarnain Rashid, Umar Farooq, Jae-keun Jang, Seung-Hun Park  
Department of Biomedical Engineering, Kyung Hee University, Global Campus, South Korea

Now a day's smart cards are used in information technology as a portable device which can store and process data as well. Due to the data storage and processing capabilities of smart cards, they are used in many fields of the society. Health care is one of the important fields of the society where we can use smart cards as a positive addition to the healthcare standards. In this paper a smart card based wellness system is developed. The system uses smart card for personal identification and transfer of health data. A complete healthcare system is designed and implemented in which different users are issued a smart card with their personal information is written in the card, so users can use this smart card to perform different tests to measure their health and fitness level. These tests include Blood Pressure, Body balance, Body Fat, Hand Grip Strength, Agility and Legs Strength test. These health test devices are globally distributed so with one valid and authorized smart card user can perform test anywhere in the world. With the help of

this smart card user can also view his previous test results so he can easily compare his health level at different periods of time. System is developed on Microsoft, Net Platform by using object oriented architecture and UML design patterns.

**P1-56 Knowledge based rules for delineating Photoplethysmogram waveform**

Umar Farooq, Zulqarnain Rashid, Dae-Geun Jang, Jae-Keun Jang, Seung-Hun Park

Dept. of Biomedical Engineering, Kyung Hee University, Korea

We have developed a real-time algorithm for detection of onsets and peaks in photoplethysmogram (PPG). The algorithm relies on the analysis of upslope of PPG waveform and suppresses the remainder of the signal. Algorithm automatically adjusts detection parameters periodically to adapt with varying beat morphologies and fluctuations in baseline. Two independent PPG waveform database are utilized for performance evaluation of onsets and peaks. The algorithm achieved an error rate of 2.16%, sensitivity 98.34% and positive predictivity of 99.52% for onset detection. As to the peak detection, algorithm achieved an error rate 1.35%, sensitivity 99.62% and positive predictivity of 99.02% within an acceptance level of 16 ms.

**P1-57 Anthropometric Parameters Extraction Using ID Information**

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The aim of this study is to extract the anthropometric parameters used for analysis of postural disorder. Algorithm was designed for body segmentation and extraction of bio landmarks from each segment using 1D information from 2D images. Segment analysis was based on extreme points extracted on the basis of peak and valley approach from each segment. These were mostly the joints in lower part and ear, nose in head part. Data used for this work is a collection of images from males and females of different ages. Anthropometric parameters like ratios of different body segments, lengths, areas, angles of deviation with respect to plum line were calculated for posture analysis.

**P1-58 부정기적 발생 신체이상 모니터링 블랙박스 장치개발에 관한 연구**

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계명대학교 기계자동차공학과

In this study, a black-box for monitoring abnormal symptoms that irregularly occur in the body during sleep was developed. If a symptom occurs, the system records the patient's condition in order to provide information which can be utilized in the treatment. First, the sensors are attached on some locations of human body being proper to check a specific type of abnormal body reaction. Second, if abnormal signal occurs, the lamp, alarm and network camera operates at the same time and stores the signal data and video data.

**P1-59 태권도장의 아이폰을 통한 품새 교육프로그램의 교육효과, 재등록 및 추천의도와의 관계분석**

하인숙, 차은중, 이태수

충북대학교 의용생체공학과

This paper analyzed the effect of smartphone app in Taekwondo academy. iPhone app was self-developed to display Taekwondo education contents for Pumsae training. From the viewpoint of education, reregistration and recommendation effect, it showed statistically significant difference in 196 trainee sample survey. Therefore, it would make a great contribution to the growth of Taekwondo.

**P1-60 부정맥 환자의 모니터링을 위한 R-peak 값 검출 알고리즘**

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Arrhythmia is a term for any of large and heterogeneous group of conditions in which there is abnormal electrical activity in the heart. The heart beat may be too fast or slow, and may be regular or irregular. Arrhythmia patients show symptoms of dizziness, faint and chest pain, and a seizure or convulsions. Arrhythmia not appear symptoms until to feel sickness, so they must know whether themselves have arrhythmia. In this study, a QRS detection algorithm find R-peak which is good at detection arrhythmia for QRS width and R-R interval.

# P1-61 패치형 원격심전도 모니터링시스템 심전도 신호의 R wave 자동검출 알고리즘

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Recently, remote monitoring with a mobile personal ECG using a patch-type electrode (patch-type ECG remote monitoring system: PTERMS) has been used in a variety of conditions. Therefore, a new, simple, and easily implemented method for R wave detection from mobile ECG signals is needed. We developed the new algorithm using a difference operation for the detection of R waves from a mobile personal ECG using patch-type electrode. We evaluated the algorithm using the data acquired from PTERMS for validation purposes. The proposed R wave detector achieved a detection rate of approximately 99.7 % within one standard deviation. The results obtained are discussed in relation to efficient R-wave detection algorithms.

# P1-62 3단계 데이터 암호화에 기반한 개인건강기록 장치 구현

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Personal health record is noticed as hot topic in the healthcare industry. Recently importance the security of health record is increased in the u-health environments, because the personal health record contains basic information and medical health record of individual. Therefore, in this paper, we propose a personal health record system based on triple data encryption standard to improve the security of personal information.

# P1-63 국내 의학용 스마트폰 어플리케이션의 분류 및 분석

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충북대학교 의용생체공학과

Smartphone apps for medical applications were classified and analyzed to investigate the current state and trends in Korea. Medical apps, developed in Korea, were classified by bottom-up and top-down strategy. Bottom-up strategy classified apps by the similarity of their functions and applied fields, which were registered in App Store and T-Store.

Top-down strategy followed the classification method of mHealth Initiative, which was presented in "The 12 mHealth Application Clusters". Their percentage in total apps was only 1-2 percent and thought to have limits to be used by medical expertise, yet. More systematic effort and investment are required to vitalize medical apps in Korea.

# P1-64 EMR 연동형 온라인 기반의 개인건강기록 백업 시스템 운용 방법

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<sup>1</sup>(주)엠디웨어

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Personal health record is a tool for managing individual health record which is possible to access and coordinate lifelong health information. As the interests of health are increased, and technologies of computer devices are grown, the need of personal health record is noticed. Therefore, in this paper, we propose an online-based application for personal health record. The proposed system is possible to interlock with electronic medical record of hospital.

# P1-65 의약 처방 모니터링 시스템 개발

전효찬<sup>1</sup>, 이인희<sup>2</sup>, 서석태<sup>3</sup>, 김민수<sup>3</sup>, 손창식<sup>4</sup>, 박희준<sup>5</sup>, 구정훈<sup>5</sup>, 김윤년<sup>5</sup>

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In the medical system, the interest for prescription system, which is possible to monitoring duplicated and/or co-prescribing contraindicated drugs, is increased. Therefore, in this paper, we propose a drug monitoring system that is possible to interlock with an electronic medical record system. The usefulness of the proposed system is evaluated through experiments based on sample drugs.

# P1-66 온라인 기반 인지평가 시스템의 구현

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Various computerized neuropsychological systems have been proposed. However conventional computerized systems are required to install specialized hardware and/or software, and intervention of evaluator is need to explain



the usage of systems and problems. Moreover the conventional systems have limitation to collect large scale data because of the differences of system formats. Therefore we propose an online-based cognitive system which is possible to measure cognitive deficit degree of post-stroke patients effectively.

**P1-67 컬러선호도에 따른 신경인지반응과 인체생리신호반응의 변화에 관한 연구**

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The colors emphasize not only the psychological attractiveness of the appearance but also stimulates psychologically and physically through an individual color's unique wavelengths. Consequently, human beings' emotions are sensitive, and they are most reactive to changes in colors. In this research Computer Neuro-cognitive Function tests and objective physical signal measurements were executed and analyzed for a quantitative and qualitative emotional mechanical design research of color design. The analysis of the experiment shows that the CNT resulted in a contracting image change for the color yellow after the stimulation; and from the increases in the parasympathetic nerve system from the color yellow, the objective physiological signal measurement evaluation result showed a relation of the evaluations with the preferred color of the test subject.

**P1-68 4가지 수면자세에서 무구속 ECG 및 PPG 측정**

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Monitoring biosignals in daily life is important. People, especially patients, spend lots of time on a bed. Therefore, non-constrainedly measuring biosignals on the bed will help check physical condition. In this paper, a silicon pad system that included ECG and driven sensors using capacitive textile and four PPG sensor array was introduced. For performance evaluation of the system, correlations of RR-intervals of reference ECG and capacitive textile ECG, and correlations of RR-intervals of reference ECG and peak-to-peak intervals of indirect contact PPG on four sleep postures were analyzed. The results showed that the designed system had an excellent performance.

**P1-69 양이 보청기 개발을 위한 오픈 플랫폼 개발보드 구현**

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Recently, development of new type binaural hearing aids are rapidly developing with the improvement of wireless communication technology. However, the previous hearing aids developer platforms can't be applied to development of binaural hearing aids, because it has not consideration for wireless communication and binaural hearing control. In this paper, we designed and implemented the open platform board for binaural hearing aids. The designed board can be programmed by general programming language and can be used wireless communication module which is applied to bluetooth. From the experimental results, we verified open platform board that was successfully transmitted and received the data for the binaural hearing control.

**P1-70 Wi-Fi를 이용한 무선 생체신호 측정기술의 개발**

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<sup>2</sup>전북대학교 화학공학과

<sup>3</sup>전북대학교 수의과대학 약리학교실·인수공통전염병연구소

This study discusses an implementation of wireless physiological measurement system using Wi-Fi. And we proposed noninvasive and continuous measurement of blood pressure pulse transit time (PTT) and physical characteristic parameter. The system is composed of the monitoring part and measurement part which is composed ECG and PPG measurement part. The wireless sensor measured physiological signal such as the ECG, SPO<sub>2</sub>, pulse rate, heart rate, and skin temperature. The remote monitoring system has the monitoring program that is communicating the wireless sensor using Wi-Fi.

**P1-71 무선 생체신호 획득 장치 개발**

김도경, 차은종, 김경아

충북대학교 의과대학 의공학교실, 충북대학교 차세대 선도

의과학전문인력양성사업단

As rapid aging and high economic level, people are interested in their wellness. And it needs to examine the condition of their health constantly. Proposed device can measure bio-signal by connecting several measurement

modules such as spirometric module, blood glucose measurement module, uro-flow measurement module and temperature measurement module. These modules can be chosen as occasion demands. In addition, developed user program enables patients to monitor bio-signal at their own place via the personal computer.

P1-72 **프로와 아마추어골퍼의 드라이브 타격음 비교**

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동아대학교 의과대학 의공학교실

Impact sounds of golf drivers show distinct characteristics according to brands and model products made by golf companies, and even in same driver, different golfers make dissimilar sounds. So, this paper was intended to record and compare the impact sounds that professional and amateur golfers conducted five times per club with three clubs. In result, we noticed there were differences in RMSs and areas in spectrograms, but little differences in frequency domains.

P1-73 **원격 데이터 전송이 가능한 비침습적 비강 음향분석장치 개발**

최혁, 박일호, 이흥만

고려대학교 의료기기임상시험연구소

고대구로병원 이비인후과

A new system for nasal sound analysis via Internet to cellular phone was investigated. Spectral analysis of the nasal sound with frequency domain and dB is an important factor in investigation of the nasal airflow pattern. Spectral analysis and frequency analysis programs for nasal sounds were developed by the Medical Device Clinical Trial Center, Korea University using the Fast Fourier Transform (FFT) technique. We characterized the following frequency spectrum using a series of variables: Low frequency (500-1000 kHz), medium frequency (1-2 kHz), and high frequency (2-4 kHz).

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## POSTERS II



KOSOMBE



## Cardiovascular Engineering

### P2-01 대동맥할 모델에서의 혈류유동 해석

서태원

국립안동대학교 공과대학 기계자동차공학과

In this study the human aorta consists of the ascending aorta, the aortic arch, and the descending aorta. The CFD simulation using the commercial ANSYS 13 based on a finite volume method for solving the Navier–Stokes equations is conducted to understand the flow characteristics in the complex geometry including three major branches at the arch, strong curvature and tapering. Our computational simulations showed the helical secondary flow originating at the ascending aorta is affected by the geometry of aortic arch. The reversed flows are observed along the inner wall of the descending aorta during diastole.

### P2-02 오실로메트릭 혈압측정에서 혈압변화의 안정성

신영숙

조선대학교 정보통신공학과

This study explores the stability of blood pressure variance of individual based on oscillometric blood pressure measurements. The study group consisted of total 52 male and female individuals. The age of individuals included from above 20 years old to 70 years old. The blood pressure measurements were recorded during 30 days in the morning. The stability of blood pressure variance was measured with each standard deviation of three features: systolic blood pressure, diastolic blood pressure, and blood pressure oscillation pattern. The measurement result of 52 people showed the stability of blood pressure variance in 8.27 mmHg (standard deviation) for systolic blood pressure, 6.45mmHg (standard deviation) for diastolic blood pressure, and 4.45 (standard deviation) for blood pressure oscillation pattern.

### P2-03 맥파 시뮬레이터용 혈류 측정 시스템 개발

장민, 이주연, 신상훈

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Pulse wave simulator simulates human cardiovascular system. Portable Ultrasound Doppler was selected as a flow measuring device because it does not affect the fluid flow with high accuracy. The experiments were divided into four phases; development of fluid circulation system, selection of fluid, compensation of measuring system, and measurement of pulsatile flow.

### P2-04 맥파 시뮬레이터용 혈압 측정 시스템 개발

우성민, 이주연, 신상훈

상지대학교 보건과학대학 한방의료공학과

The purpose of this study is to develop the pressure measurement system for pulse wave simulator without the change of fluid characteristics. Small electric pressure sensor was selected not to disturb flow. Hydrostatic pressure system was developed to calculate the current–pressure relation of the pressure sensor. Pulsatile flow generating system was developed to measure the pulsatile pressure with the developed system.

### P2-05 맥파 생성 시스템 개발

이주연, 신상훈

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The purpose of this study is to develop the pulse wave generating system. The system is composed of three parts: driving part, pressure generating part, measuring part. Linear DC motor was selected with the calculation of resistance force and moving part velocity. Piston–Cylinder type was selected to generate the flow and pressure with keeping the fluid sealing. Measuring system was designed not to disturb the fluid dynamic condition.

### P2-06 협착동맥에서의 혈류유동특성에 대한 수치해석

박영란<sup>1</sup>, 박라미<sup>1</sup>, 문아름<sup>2</sup>, 박해민<sup>3</sup>, 고현규<sup>3</sup>, 김상진<sup>3</sup>, 김진상<sup>3</sup>, 강형섭<sup>3</sup>, 김성중<sup>1</sup>, 홍철운<sup>2</sup>, 김기범<sup>3</sup>

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In this study, characteristics of the blood flow in 2–dimensional elastic vessel wall should be investigated in order to understand the blood flow in stenotic artery. Variation of the pressure and the velocity distribution are obtained using the CFD simulation. The present results enhance our understanding of the hemodynamic characteristics in a compliant stenotic artery.

### P2-07 기능 정지 시에도 환자의 생존율을 높일 수 있는 관형 심실보조장치의 개발

강성민<sup>1</sup>, 최성욱<sup>2</sup>

<sup>1,2</sup>강원대학교 기계의공학학과

<sup>2</sup>의료&바이오 융복합 연구사업단

The malfunction with VAD system is the 6% of the VAD patient's death causes and need the new idea that the trouble with the VAD does not affect the patient's heart movement and hemodynamic states. In this paper, we developed a

new pulsatile conduit VAD that has two valves and conduit shape that remove the possibility of blood regurgitation and small stationary area even when the pumping force is extremely weak and estimated its characteristics by measuring the out flow and pressure of pump at in-vivo experiments.

#### P2-08 HRV 파라미터의 다중회귀분석을 통한 실제 심장 자율신경 흥분정도 추정

이승민<sup>1</sup>, 최의근<sup>2</sup>, 오세일<sup>2</sup>, 박광석<sup>3</sup>

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As cardiac autonomic nervous activity is an important factor for human health, HRV parameter was widely used as a non-invasive method. However, relationship of HRV parameter and real cardiac autonomic nervous activity still needs to be determined. We recorded cardiac autonomic nervous activity from a dog and estimated it by HRV parameters using multiple regression method. For all segments, correlation was 0.61 and 0.84 when para-sympathetic nerve was compressed.

#### P2-09 생체분해성 고분자를 이용한 약물방출스텐트의 방출거동 분석

김동곤<sup>1</sup>, 김상호<sup>1</sup>, 박종채<sup>1</sup>, 김은진<sup>1</sup>, 신일균<sup>1</sup>, 김한기<sup>1</sup>, 엄기훈<sup>1</sup>, 전훈재<sup>2</sup>, 김은선<sup>2</sup>, 조혜진<sup>2</sup>

<sup>1</sup>(주)엠아이텍 중재의학연구소

<sup>2</sup>고려대학교 의과대학

In this study, the Biodegradable polymer coating drug-eluting stent (DES) was prepared by ultrasonic spray coating method a coronary stent with sirolimus using various molecular weight poly (lactic-co-glycolic acid) (PLGA). Drug contents of DES were increased as concentration and molecular weight of coating polymer increase. Drug release profile is continuously released from DES over 3 week. DES coated with PLGA 502H showed the most rapidly release profile because PLGA 502H is biodegradable polymer and has less molecular weight than other coating polymer.

#### P2-10 운동으로 인한 심박 회복 반응에서 금연의 즉각적인 효과

조재성<sup>1</sup>, 김도현<sup>1</sup>, 오윤배<sup>1</sup>, 이종실<sup>1</sup>, 김선일<sup>1</sup>, 김인영<sup>2</sup>, 지영준<sup>3</sup>

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<sup>2</sup>한양대학교 의과대학 의공학교실

<sup>3</sup>울산대학교 의용생체공학과

We suggested whether there is no significant difference of the HR decay among the non-smokers, but is significant difference of the HR decay in the smoking cessation group. We measured Heart rate and respiration signal in the groups and saved on computer. The acquired data could provide information about short-term effect of smoking cessation. As the result of the testing for a month or two, we found that there was no significant difference of pattern and its gradient of the heart rate recovery of the non-smokers. But there was significant difference between before and after smoking cessation of the quitting smokers.

#### P2-11 청력 손상에 따른 청진 혈압 측정 정확도 비교

송수화, 홍성준, 이종실, 김인영, 김선일

한양대학교 의용생체공학과

The auscultation method is influenced by the hearing of observers. If the observer lost hearing as compared with normal person, it is possible to measure blood pressure inaccurately. The hearing test is usually applied from 250 Hz or 500 Hz as the lowest frequency, but the frequency range of Korotkoff sound is 20 Hz to 250Hz. Therefore, if the observer was diagnosed as normal hearing through the hearing test, it is difficult to judge whether the observer is normal or not in the specific frequency range of Korotkoff sound. Hence, we tested how the hearing loss affect the accuracy of blood pressure measurement in the auscultatory method using the hearing loss simulator.

#### P2-12 Korotkoff sound에 대한 소리압력 레벨 분석

박대규, 안대윤, 김동환, 박영민, 이종실, 김인영, 김선일

한양대학교 의용생체공학과

In this study, to make most similar to the gold standard method of NIBP (Non-invasive Blood Pressure) that is our goal. Korotkoff sound frequency is below 250Hz. Hearing of human can listen from 20 to 2000Hz. Whenever blood pressure measuring, each observer show different blood pressure value. This problem is different hearing threshold of each person. But, if observer does not listen to k-sound of low frequency then it is different blood pressure value. The K-sound data changes in SPL and we compare the changed in SPL with Equal-Loudness contours[1].

### P2-13 직접방식 DR (Digital Radiography) 영상의 고효율을 위한 Double Layer

#### Photoconductor의 전기적 특성

김대국<sup>1</sup>, 김성현<sup>1,2</sup>, 이지윤<sup>1,2</sup>, 노성진<sup>1</sup>, 장기원<sup>1,2</sup>, 윤경준<sup>4</sup>,  
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Since a few years, flat panel digital X-ray detectors are researched animatedly to replace the image intensifier for dynamic X-ray imaging in medical market. These flat panel digital X-ray detectors are distinguished to indirect and direct method. Indirect method is that scintillator (such as CsI(Tl), CsI(Na), Gd2O2S:Tl) convert X-ray quanta to visible light and the light detected from photodiode array. And direct method is that electron-hole pair generated from photoconductor (like a-Si, a-Se, CdTe, CdZnTe, HgI2, PbI2) by exposed X-ray and the E-H pairs are respectively gathered to the photo-conductor top and bottom layer because of supplied input high voltage. These separated E-H pairs are detected from TFT (or capacitor) array after storage. But indirect method has a defect like light burring. It makes special resolution to bad and is cause of information loss. To avoid this problem, direct method is studied in many laboratories for application of X-ray detector.

### P2-14 MREIT conductivity imaging of breast using less than 1 mA injection currents

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Latest MREIT experiments of *in vivo* human subjects successfully produced conductivity images using 3 mA current injections. *In vivo* human and disease model animal experiments still require further reduction of imaging currents. In this paper, we describe an MREIT breast phantom imaging experiment to show its feasibility as a new tool to diagnose breast tumor. Noting that the breast consists of soft tissues and relatively small imaging region, we performed breast phantom MREIT imaging experiments using a multi-channel breast coil. With injection currents of less than 1 mA, we could produce conductivity images of a breast phantom which distinguish two different tissues of

a small conductivity contrast. We suggest future development of fast pulse sequences and optimized electrode configurations for better image quality, which will be followed by animal and human experiments.

### P2-15 Sparse-view CT imaging 영상재구성 알고리즘 비교

김혜선, 이수열, 조민형

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CT is one of the convenient method for observing inside of objects. However, radiation exposure occur side effects. So reduce the number of projections to reduce x-ray exposure. When the number of projections reduced, there make streak artifact. In this paper, to avoid streak artifact, performed several iterative reconstruction algorithms, such as simultaneous iterative reconstruction technique (SIRT) or conjugate gradient total variation minimization method (CG-TV), and compare images.

### P2-16 High-resolution MREIT conductivity imaging with a micrometer pixel size

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Recent experimental MREIT studies demonstrated conductivity image reconstructions of postmortem and *in vivo* animal and human subjects with a few millimeter pixel size. In order to visualize a conductivity distribution within a tissue or a small animal, it is necessary to develop a high-resolution MREIT technique. In this study, we demonstrate the capability of MREIT to perform conductivity imaging at a spatial resolution with a micrometer pixel size. The experimental results using a 4.7T research MRI scanner with a multi-echo ICNE pulse sequence and high-performance RF coils demonstrate that we can distinguish two different anomalies in reconstructed conductivity images with a spatial resolution as low as 400  $\mu\text{m}$ . We plan to apply the developed experimental method to *in vivo* head imaging of small animals to investigate the feasibility of functional MREIT.

### P2-17 고해상도X-선국부 단층영상 촬영술에 대한 연구

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A conventional local tomography technique has contrast anomalies. It is originated from the imperfect measurement of projection images, because almost all of case x-ray

detector is smaller than projection size of objects. In order to avoid this problem, local tomography [2], zoom-in tomography technique has been developed [1]. New method, elimination of out of ROI component from measured projection images, for avoiding contrast anomalies has tried and it include the results.

#### P2-18 저선량 CT를 위한 광자계수형 검출기 기초연구

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경희대학교 국제캠퍼스 생체의공학과

The improvement of image-scanning method, image reconstruction method, and the ability of x-ray detection are needed to make low-dose computed tomography (CT) which is the latest trend in x-ray CT field. In this study, we have tested the performance of a CdTe (cadmium-telluride) detector that is a photon-counting detector with high sensitivity in order to evaluate the potential for low-dose CT utilizing a CdTe detector.

#### P2-19 대면적 CMOS 디지털 래디오그래피 디텍터의 정량적 성능평가

감수화, 조민국, 한종철, 윤승만, 조옥라, 김호경  
부산대학교 기계공학부

We have measured the imaging performance of large-area CMOS digital radiography detectors in terms of modulation-transfer function (MTF), noise-power spectrum (NPS), and detective quantum efficiency (DQE). From the measured data, characteristic curve includes small-signal nonlinearity, which means the we cannot directly apply DQE evaluation method based on linear-systems approach. This study will be useful to understand the performance characteristics of large-area CMOS detectors as a dynamic imaging detector.

#### P2-20 X선 스펙트럼을 이용한 광자계수 방식 선형 어레이 디텍터의 에너지 캘리브레이션

조옥라, 윤한빈, 김호경  
부산대학교 기계공학부

While conventional flat-panel detector integrates charges from incident x-ray energy flux during integration time, photon-counting detector counts each photon. Thus photon-counting imaging can discriminate materials in object. We have calibrated threshold voltage of photon-counting linear detector array into energy using incident x-ray spectrum to acquire energy-discriminating spectrum.

The developed simple method will be very useful for the operation of the single-channel flat-panel photon-counting detector.

#### P2-21 Comparison of Tomosynthesis Algorithms

Gao Jie, M.H. Cho, S.Y. Lee

Department of Bio Medical Engineering, Kyung Hee University, Yongin Korea

In tomosynthesis systems, a discrete series of projection radiographs were acquired by moving the x-ray source and digital detector simultaneously in opposite directions. We investigated three representative reconstruction methods and made the quantitative comparison between the tomosynthesis algorithms.

#### P2-22 초음파 스캐너를 이용한 방광 용적 측정 알고리즘 개발

강래훈, 조민형, 이수열  
경희대학교 생체의료공학과

For non-invasive bladder volume measurement, bladder images acquired from portable ultrasound bladder scanners have been used. However, in real practice, the bladder wall is often almost invisible particularly in the region where the ultrasound beam propagates tangentially to the bladder surface. This weak intensity at the bladder wall in images can lead to significant errors in bladder volume estimation. We propose a new robust method for non-invasive bladder volume measurement from ultrasound images. The main objective of this study is to improve the consistency of the bladder volume measurement. With bladder mimicking phantoms, we have verified the proposed method.

#### P2-23 A Non-linear Approach for Local Contrast Enhancement of Medical Images

E. Michel, S. Y. Lee, M. H. Cho

Department of Biomedical Engineering, Kyung Hee University, Korea

Several physical factors during medical image acquisition processes e.g. the object's attenuation or its density, may lead to a poor image contrast. We describe a nonlinear algorithm for image contrast enhancement, based on local statistical information and intensity manipulation. An example of x-ray image is included to show the performance of our approach.



#### P2-24 3차원 포인트 템플릿 정합을 이용한 CT영상 뇌실 자동 추출

조유창<sup>1</sup>, 박찬수<sup>1</sup>, 김영재<sup>1</sup>, 김지훈<sup>2</sup>, 김광기<sup>1</sup>

<sup>1</sup>국립암센터 융합기술연구부 의공학연구과

<sup>2</sup>서울대학교병원 영상의학과

The volume of brain ventricular system is crucial information for neurodiagnosis and neurosurgery. Although brain ventricular system shows differences based on race, gender, or individual characteristics, patients with brain disease show significant differences in volume when compared to normal cases. The volume of brain ventricular system of a patient with brain disease is either smaller or larger than that of normal brain depending on the type of disease. In this study, authors proposed a protocol for the automatic segmentation of human brain ventricular system using a digital image processing technique, 3D point set template registration from CT images.

in it. The proposed method provided more accurate information to diagnose the OSAS patients than those in recent researches.

#### P2-27 Crank-Nicolson 방법을 활용한 집중초음파 열학산의 시뮬레이션

고유미, 박동희, 박진감, 유홍일, Saad, 문상협, 서종범

연세대학교 의공학과

The spatial distribution of tissue temperature is an essential indicator of thermal therapy progress such as HIFU surgery. The temperature distribution caused by acoustic energy of HIFU transducer simulated using 3-D diffusion equation. Using diffusivity constant of biometaterials, temperature at focus reduces up to 22% in duration of 10 second.

#### P2-25 X-ray CMOS image sensor의 테스트를 위한 Data Acquisition Module 개발

조민식, 배준형, 강동욱, 이대희, 김명수, 유현준, 이채훈, 김찬규, 조규성

KAIST 원자력 및 양자공학과

In this research, we present a compact data acquisition system for digital radiography, based on a CMOS image sensor with 190 x 190 pixels fabricated using 0.25  $\mu\text{m}$  standard CMOS process. Commercial systems are not proper to test general sensors, because it is developed for specific purposes. Therefore we developed a special system for testing common sensors. To characterize the performance of the sensor, the system was implemented for controlling the sensor and acquiring X-ray radiological images. Also a friendly user interface was developed to provide image presentation and sensor operating parameter.

#### P2-26 광흐름을 이용한 폐쇄성 수면 무호흡 증후군을 가진 소아 비만 환자의 기도 변화 분석

우종형, 이 훈, 권순동, 이아영, 김동윤

연세대학교 의공학과

In this paper, we used the optical flow method to analyze the upper airway dynamic changes in during respiration in children with obstructive sleep apnea syndrome (OSAS) and control subjects. The respiratory-gated magnetic resonance images are used to obtain the airway shape information. By using the optical flow method, we could quantify not only the area of the upper airway but also the directional changes

## Medical Nano and Microtechnology

### P2-28 ZnCdSe alloy 나노 양자점 합성 및 발광 특성 연구

이지윤<sup>1</sup>, 오경민<sup>1</sup>, 이영규<sup>1</sup>, 김진선<sup>1</sup>, 조윤재<sup>1</sup>, 차병열<sup>2</sup>, 남상희<sup>1,3</sup>

<sup>1</sup>인제대학교 의공학과

<sup>2</sup>김해 의생명 센터

<sup>3</sup>인제대학교 의료영상연구소

Metal-Semiconductor which contains size of Nanometer has completely different properties from micrometer sized of particle not only physical, chemical properties but also photoelectron properties. Recently, some research show NANO Compound Semiconductor being applied to the numerator of a circuit, photoelectric device and sensor are in progress. In this research, we have manufactured NANO-Fluorescent substance synthesizing ZnCdSe, multi component Quantum Dot by using the way of non-hydrolytic hot solution phase, and produced the structure of ZnCdSe/ZnSe core/Shell by synthesizing it with coating ZnSe. After synthesizing the structure, we confirmed that this structure of ZnCdSe/ZnSe core/shell is synthesized successfully as studying UV lamp, analyzing TEM and comparing-ZnCdSe Quantum Dot to luminous properties before and after the formation of ZnSe shell.

### P2-29 체내 이식형 PDMS-피복 연결용 전선

김성환, 정승민, 김정훈, 문진희, 이상훈

고려대학교 보건과학대학 생체공학학과

Several kinds of implantable medical devices (IMDs) were developed for purpose of diagnostic and therapies. Those devices need implantable wire, which connects each part of their devices. In this paper, we introduce an implantable electrical wire encapsulated by PDMS. By using PDMS as encapsulation material, we can expect great biocompatibility. And its flexibility has advantages of reducing loading effects and flexibility. To evaluate its capabilities, several tests were carried out. First its elastic modulus was found out by tensile test. And durability test has done by testing couple of experiments. And biocompatibility was confirmed by implanting the wire to mouse's hypodermic tissue.

### P2-30 투과형 LSPR 바이오센서에서 국소 표면 플라즈몬의 분포와 감도 특성의 상관관계 연구

김낙현, 정우경, 변경민

경희대학교 전자정보대학 생체공학학과

A transmission-type localized surface plasmon resonance (LSPR) biosensor with periodic metallic nanogratings is

explored to study the correlation between the plasmonic field distribution and the sensor sensitivity. The LSPR configuration is modeled as gold nanogratings with a rectangular profile deposited on a transparent glass substrate. The numerical results using rigorous coupled-wave analysis and finite-difference time-domain method demonstrate that localized plasmonic fields significantly affect the sensitivity and in especial, target localization on nanograting sidewalls contributes to an enhanced sensitivity dominantly due to a strong overlap with localized plasmonic fields.

### P2-31 나노임프린트 리소그래피를 이용한 대면적의 고감도 SPR 센서칩 제작

정우경, 변경민

경희대학교 전자정보대학 생체공학학과

We describe the fabrication of one-dimensional SiO<sub>2</sub> nanograting arrays as a surface plasmon resonance (SPR) sensing substrate via nanoimprint lithography. Dielectric nanogratings are fabricated on a 40-nm thick silver film deposited on a glass substrate. The grating pattern with a period of 300 nm and a depth of 100 nm is employed to increase the surface reaction area for sensitivity improvement. A larger-area sensor surface of 5 mm × 5 mm could allow the reproducibility of sensor performance and the low-cost and high-throughput fabrication of SPR biosensor chips.

### P2-32 나노 역학적 검출에 의한 생체 분자간 상호작용 이해

이규도<sup>1</sup>, 박진성<sup>2</sup>, 양재문<sup>3</sup>, 엄길호<sup>2</sup>, 나성수<sup>2</sup>, 이상우<sup>1</sup>, 윤대성<sup>1</sup>, 권태윤<sup>1</sup>

<sup>1</sup>연세대학교 의공학과

<sup>2</sup>고려대학교 기계공학과

<sup>3</sup>연세대학교 진단방사선학과

Characterization and control of proteolysis of peptides by specific cellular protease is a *priori* requisite for effective drug discovery. In this work, we have demonstrated the nanomechanical, in situ, label-free detection of proteolysis of tetrapeptides attributed to protease (Cathepsin B) by using resonant microcantilever immersed in buffer solution. Our label-free detection using resonant microcantilever is based on the measurement of resonant frequency shift induced by proteolysis on the cantilever surface. It is shown that our resonant microcantilever has enabled the quantification of proteolysis efficiency with respect to enzyme concentration. More remarkably, our microcantilever has allowed us to dictate the kinetics of proteolysis such that the frequency shift driven by protease is well fitted to Langmuir kinetic model. It is implied that nanomechanical biosensor may enable the characterization of peptide-enzyme (and/or protein-drug) interactions, related to drug discovery or screening of drug efficacy.

## Neural Engineering

### P2-33 SD 소켓을 이용한 체외 신경세포 센서칩 시스템 개발

명준오, 남윤기

KAIST 바이오 및 뇌공학과

Planar-type Microelectrode Array (MEA) is currently the fundamental tool for measurement and analysis of extracellular action potentials. This MEA has been proposed as a cell-based biosensor platform that can sense electrical activities from in vitro neural tissues such as brain slices or dissociated neurons. We are currently using MEA with 60 channels. However, when MEA with a few channels is designed, it is possible to enlarge electrode size. And we can think neural chip including MEA with push-pull way for easy contact from or separation to outside. Here we designed a multi-neural chip recording system that is composed of glass chip, PCB chip adapter, SD memory card socket, and low-noise OP-AMP ICs.

### P2-34 전기화학적 폴리도파민 박막 적층법을 통한 신경인터페이스 설계 기술

강경태<sup>1</sup>, 이석영<sup>2</sup>, 최인성<sup>1,2</sup>, 남윤기<sup>2</sup>

<sup>1</sup>KAIST 화학과

<sup>2</sup>KAIST 바이오 및 뇌공학과

In this study, we report a novel method for a facile site-selective surface functionalization by electrochemically polymerizing dopamine molecules at moderate pH. The electrochemical polymerization of dopamine molecules was triggered by applying positive voltage to the electrode surface while reducing pH of the solution to 6.0, and the deposited polymer films exhibited reproducible characteristics. Time-dependant increase of the thickness of deposited polymer films were observed, and subsequent or *in situ* conjugation of biomolecules to the films was implemented in order to render the films biofunctional. Polydopamine films were patterned on microelectrode arrays (MEAs) by applying voltage only to selected electrodes, as a demonstration for the site-selective functionalization.

### P2-35 심부뇌자극 시 자극 아티팩트 제거를 통한 기저핵 뉴런의 응답특성 관찰

류상백<sup>1</sup>, 배은경<sup>1</sup>, 황용섭<sup>2</sup>, 이현주<sup>3</sup>, 임창균<sup>3</sup>, 장진우<sup>2</sup>, 신형철<sup>3</sup>, 김경환<sup>1</sup>

<sup>1</sup>연세대학교 보건과학대학 의공학과

<sup>2</sup>연세대학교 신경외과 뇌과학 연구소

<sup>3</sup>한림대학교 의과대학 생리학교실

Deep brain stimulation (DBS) is widely used for the treatment

of neurological diseases such as Parkinson's disease and neuropathic pain. Clinical effect of DBS is dependent on specific stimulation parameters such as stimulation frequency and the optimal parameters should be determined based on relevant neural activity as well as behavior. In this study, we investigated response characteristics of basal ganglia neurons during electrical stimulation of pertinent areas in deep brain using artifact removal technique.

### P2-36 이식형신경신호 기록 및 송수신 장치를 위한 무선충전시스템 개발

임창균<sup>1</sup>, 고진수<sup>1</sup>, 이현주<sup>1</sup>, 서인석<sup>1</sup>, 신재우<sup>1</sup>, 박재홍<sup>1</sup>, 신형철<sup>1</sup>, 안재목<sup>2</sup>

<sup>1</sup>한림대학교 의학과 생리학교실

<sup>2</sup>한림대학교 전자공학과

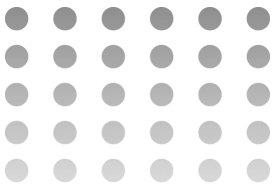
The greatest challenge to improve power consumption efficiency with size minimization in implantable wireless neural recording systems. We designed a prototype of implantable wireless power charging system for neural signal transmission. The system consists of a micro-controller (MSP430F2616, TI, USA) for acquisition of neural signal through implanted electrodes and a Bluetooth-based wireless module (FB155BC, FirmTech, Korea) for transmission of neural signal to external receiver, and a wireless charging unit. This system was successfully used for real time recording of single neuron action potentials after implantation into experimental animal's brain. This system could fulfill in vivo requirements in neuro-prosthetic applications.

### P2-37 LabVIEW 기반의 생체 이식 전극 Soak Test 시스템

신수원, 민규식, 김성준

서울대학교 공과대학 전기공학부

Neural prostheses are implanted in patient's body to substitute or restore the function of impaired nerve system through electrical stimulation. For chronic operation of the implanted devices, the long-term safety and durability of stimulating electrodes should be checked before implantation. For this purpose, long term soak test is widely used, where electrodes or devices are immersed in physiological saline and continuously monitored. In this paper, we suggest an automated implantable electrode soak test system using LabVIEW.



## P2-38 수화방법에 의한 TiOx 나노 구조체 제작

김용희, 이봉준, 백남섭, 정명애, 정상돈

한국전자통신연구원 신경계 인터페이스연구팀

TiOx nanostructure was fabricated through a simple hydrothermal reaction of alkali with the TiOx precursor-coated indium-tin oxide substrate. The electrochemical impedance spectroscopy (EIS) showed that the impedance of TiOx nanostructure is lower than that of TiOx film. And also neuronal cells are grown on both TiOx nanostructure and TiOx film. It was obvious that the cell morphology is more homogeneous and uniform on TiOx nanostructure while the cells on TiOx film forms cluster. These results suggest that the TiOx nanostructure could be potentially useful as a material for neural electrode and bio-scaffold.

## P2-39 이식형 자기 자극의 시뮬레이션을 이용한 연구

구호, 김형일, 김소희

GIST 의료시스템학제전공

Cortical stimulation therapy is increasingly used in various neurological disorders as an adjunct medical therapy. Magnetic stimulation using electromagnetic induction to induce secondary electric currents using a rapidly changing magnetic field is a method for cortical stimulation. Magnetic stimulation has benefits as it does not require direct contact of metal with tissue. Moreover, the implanted magnetic stimulation can more consistently take effect in compared with TMS (Transcranial Magnetic Stimulation), a noninvasive method for cortical stimulation. In this study, the possibility of implantable magnetic stimulation is investigated by computer-based simulation.

## P2-40 파킨슨 환자의 진전 증증도와 위상 관계 분석

김상경<sup>1</sup>, 전효선<sup>1</sup>, 전범석<sup>2</sup>, 박광석<sup>3</sup><sup>1</sup>서울대학교 공과대학 협동과정 바이오엔지니어링전공<sup>2</sup>서울대학교병원 신경과<sup>3</sup>서울대학교 의과대학 의공학교실

Tremor is a representative manifestation in patients with Parkinson's disease. It is rhythmic and alternating oscillation, and most of those are appeared in the frequency range from 3 to 10Hz. As dynamics in Parkinsonian tremor varies continuously, we investigated whether phase dynamics between both hands were related to instant severity. We recruited 17 patients with Parkinson's disease and they were evaluated during rest tremor for sixty seconds. Hilbert

transform was applied to extract phase from each signal. Next,  $\rho$  index based on Shannon entropy was calculated for evaluation. As a result,  $\rho$  index had a tendency to be higher with larger amplitude in tremor. Consequently, we concluded that severity in Parkinsonian tremor was related to phase dynamics between both hands movement.

## P2-41 정상망막과 변성망막을 위한 최적의 전기자극 범위 제안

안근노<sup>1</sup>, 류상백<sup>2</sup>, 김경환<sup>2</sup>, 구용숙<sup>1</sup><sup>1</sup>충북대학교 의과대학 생리학교실<sup>2</sup>연세대학교 보건과학대학 의공학과 신경공학연구실

Stimulation with voltage- and current-controlled pulses, RGCs from both wild-type and *rd/rd* mice responded, however the response pattern is very different; single peak within 100 ms vs. multiple peaks (~4 peaks) with ~10 Hz rhythm within 400 ms. Anodic phase-first biphasic voltage-controlled pulse is more efficient for stimulation than biphasic current-controlled pulse based on lower threshold charge density needed. The threshold charge densities for activation of RGCs are overall more elevated in *rd/rd* mouse compared to wild-type mouse. Here, we propose the stimulus range for wild-type and *rd/rd* retina when the optimal modulation of RGC response is possible.

## P2-42 방광염 유발 전후의 척수 신경 활동성 변화 측정

박재홍, 임창균, 이현주, 고진수, 신재우, 서인석, 신형철

한림대학교 의과대학 생리학교실

Extracellular single neuron activities were recorded through multi-channel micro-wire electrodes from the lumbar 6 to the sacral 1 dorsal horn of anesthetized rats. Evoked responses (ER) were recorded in response to saline infusion (rate 0.5 ml/min) into the rat bladder until urination and spontaneous activities (SA) were recorded for 2 min before ER recording. This procedure was repeated at 30, 20, and 10 min prior to acetic acid (AA, 0.5, 1.0, 3.0 or 5.0%) infusion into bladder and at 10, 20, 30, and 60 min post AA infusion. The results showed that spontaneous activity was altered only at 5.0% AA. However, %Net response (100x(ER-SA)/SA) was decreased after different doses of AA infusion. This result may provide one of basic physiological understandings required for future development of a closed-loop bladder control system.

**P2-43 무선기반 cyclic voltammetry를 이용한  
카이닉산 유발 발작 도중 아데노신 분비의 실시간  
측정**

손영민<sup>1</sup>, 곽필애<sup>1</sup>, 이현주<sup>2</sup>, 임창균<sup>2</sup>, 신형철<sup>2</sup>  
가톨릭대학교 의과대학 신경과학교실

Adenosine, as the brain's endogenous anticonvulsant, is considered to be responsible for seizure arrest and postictal refractoriness. We performed ictal EEG & co-monitoring of neurotransmitter recording by WINICS (wireless instantaneous neurotransmitter concentration system) in the acute hippocampal seizure model of rat. Intermittent and phasic release of adenosine was clearly observed only at a period of slow, large-amplitude spike and wave, but not at the low-amplitude fast or repetitive spikes among the recurrent ictal EEG pattern. It shows that the slow phase of spike-wave complex may be linked to a suppression of neuronal hyperexcitability via adenosine release.

**P2-44 중이내 망간추적자 주입방법을 이용한  
청각신경경로 영상화 연구**

유승준, 이희중, 장용민, 송희진  
경북대학교 대학원 의용생체공학과

Manganese-enhanced MRI is increasingly used for functional characterization of a wide variety of neural systems in animal brain. In the present study, we report the use of Mn2+ as tracer in exploring the transduction from middle ear cavity to auditory pathway via cochlea during in vivo MRI.

**P2-45 뇌-컴퓨터 인터페이스를 위한 EEG 채널간  
연결성 특징 추출**

정윤기, 김성필  
고려대학교 뇌공학과

EEG-based brain-computer interfaces (BCIs) using motor imagery extract features from the somatosensory rhythm (SMR) during imagination of moving body parts. The spectral analysis using Fourier transform or wavelet transform has been mainly used to extract features from the SMR. To explore possibilities of extracting different features for motor imagery beyond such a conventional feature set, we investigated connectivity between EEG channels using correlation coefficients and how this new feature space represented various types of motor imageries. We found that the connectivity patterns were different across the left hand, the right hand, and the foot imagery.

**P2-46 단기 기억 과정 중의 EEG 감마 리듬 동기화를  
통한 뇌 연결성 분석**

강재환, 최성현, 김성필  
고려대학교 뇌공학과

This study aims to investigate the phenomenon of large-scale brain functional connectivity during the memory retrieval. To this end, we analyzed the 58-channel EEG signals from the memory retrieval task using the phase synchrony technique with the 43Hz target frequency (gamma activity). We observed that the spatio-temporal patterns of the phase synchrony connections during the memory retrieval differed from those without memory retrieval. This result indicates that the functional connections between different brain regions through the gamma oscillation may be altered when the memory is retrieved.

**P2-47 자서전적 정보의 의미 분석 시 사건관련  
뇌전위의감마대역 파워 및 위상동기화 특성분석**

최정우, 이종구, 김경환  
연세대학교 의공학과

We investigated neural activity and inter-regional functional connectivity during semantic processing of autobiographical knowledge, using time-frequency analysis, phase synchronization (PS), and graph theoretical analysis of event-related EEGs. Significant differences in spatiotemporal pattern of gamma-band power and PS were found between correct sentence and autobiographical knowledge violation. Stronger gamma-band PS were identified for correct sentence. Moreover, for correct sentence, the PS network pattern was closer to 'small world network' which is considered as the most efficient architecture for inter-regional interaction.

## Orthopedic and Rehabilitation Engineering

### P2-48 앉은 자세와 선 자세에서의 전경골근과 비복근의 전기역학적 지연 시간 분석

정홍영, 김지원, 권유리, 김효희, 엄광문  
건국대학교 의학공학부

The purpose of this study was to analyze electro-mechanical delay (EMD) during quiet standing and sitting posture. Twenty four young subjects (12 men and 12 women) participated in this study. Subjects were instructed to perform maximal, voluntary, isometric contraction of tibialis anterior and gastrocnemius muscle in reaction to auditory stimulus to determine EMD. EMD of standing posture was significantly longer than that of sitting posture.

### P2-49 정상 한국인 아동과 성인의 악력 조절 방법에 관한 연구

유진영, 이현주, 신성욱, 안세중, 정성택  
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The purpose of this study is to analyze the method to the grip force control of children and adults. Subjects in the study are 4 to 6 years old children and university students. Evaluation method is a function which controls grip force and traces according to suggested trapezoid graph. This analysis used value of correlation coefficient. In result, the method to grip force control of children was 'jump and wait'. In addition, children after 6 years of age have the ability to grip force control similar to adults.

### P2-50 특발성 파킨슨환자의 완서증에 대하여 뇌심부 자극과 약물의 효과

김유미<sup>1</sup>, 김지원<sup>1</sup>, 권유리<sup>1</sup>, 엄광문<sup>1</sup>, 이혜미<sup>2</sup>, 장지완<sup>2</sup>, 고성범<sup>2</sup>  
<sup>1</sup>건국대학교 의학공학부  
<sup>2</sup>고려대학교 의과대학 신경과

The purpose of this study is to investigate the effect of DBS (Deep Brain Stimulation) and medication on FT (Finger Tapping) movement in Patient with Idiopathic Parkinson's disease. Five patients with Idiopathic Parkinson's disease participated in this study. Angular velocity of finger movement was measured under various conditions (medication on/off and DBS on/off). As analysis indices, RMS (root mean square) angular velocity and angle were used. RMS angular velocity significantly differed between

medication on and off states, but not between DBS on and off states. Neither medication nor DBS affected RMS angle. This result suggests that medication is more effective than DBS on bradykinesia, specifically on the angular velocity.

### P2-51 수동적인 어깨 신전시의 정상인과 유착성관절낭염 환자의 모멘트 비교

김혜진<sup>1</sup>, 이상기, 김지원<sup>1</sup>, 권유리<sup>1</sup>, 엄광문<sup>1</sup>, 이정현<sup>2</sup>, 이승현<sup>2</sup>, 김동휘<sup>3</sup>  
<sup>1</sup>건국대학교 의학공학부  
<sup>2</sup>창명제어기술(주)  
<sup>3</sup>고려대학교 병원 재활의학과

The purpose of this study was to analyze the moment during passive shoulder extension exercise in normal subjects and patients with frozen shoulder. Shoulder moment by CPM (continuous passive motion) with torque sensor was measured. Moment of normal subject showed pattern of sinusoid by gravity effect. On the other hand, Patient showed pattern of resistant moment by shoulder pain effect. These results suggest that it is possible to apply to biofeedback CPM by detecting shoulder pain using torque sensor.

### P2-52 다양한 페달링 속도에 따른 근전도 패턴분석

허재훈<sup>1</sup>, 김지원<sup>1</sup>, 권유리<sup>1</sup>, 엄광문<sup>1</sup>, 권대규<sup>2</sup>  
<sup>1</sup>건국대학교 의학공학부  
<sup>2</sup>전북대학교

The purpose of this study is to analyze EMG (Electromyogram) pattern during cycling exercise with various pedaling rate in normal subjects. Ten young men ( $23.8 \pm 2.2$  yrs) participated in this study. EMG of vastus lateralis, rectus femoris and biceps femoris muscles were measured during 20, 40 and 60 RPM respectively. EMG results revealed that response of all muscles advanced as increased pedaling rate

### P2-53 계단하강보행동안 체성감각자극이 노인의 발목 신전 근육에 미치는 영향

곽기영<sup>1</sup>, 소하주<sup>1</sup>, 김성현<sup>3</sup>, 김남균<sup>4</sup>, 김동욱<sup>2,5</sup>  
<sup>1</sup>전북대학교 대학원 헬스케어공학과  
<sup>2</sup>전북대학교 공과대학 바이오메디컬공학부  
<sup>3</sup>전북대학교 헬스케어기술개발사업단  
<sup>4</sup>(주)식스티 플러스  
<sup>5</sup>전북대학교 고령친화복지기연구센터

The purpose of this study was to investigate ankle joint moment of the elderly as it changed by somatosensory

stimulation during the descent down three stairs of different heights. Subjects climbed down a stair at four stimulation conditions, which are non-stimulation, tibialis anterior tendon stimulation, achilles tendon stimulation, tibialis anterior-achilles tendon stimulation. Motion capture data were collected using 3D optoelectric motion analysis system that utilizes active infrared LEDs, near infrared sensor. The obtained motion capture data was used to build 3D computer simulation model. The results show that ankle joint moment of the elderly changed with somatosensory stimulation as they descended the stairs.

**P2-54 족관절에 인가한 진동자극이 계단 하강 동작에서 압력중심의 변화에 미치는 영향**

소하주<sup>1</sup>, 박기영<sup>1</sup>, 김성현<sup>4</sup>, 김남균<sup>5</sup>, 김동욱<sup>2,3</sup>

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<sup>2</sup>전북대학교 공과대학 바이오메디컬공학부

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<sup>4</sup>전북대학교 헬스케어기술개발사업단

<sup>5</sup>(주)식스티플러스

The purpose of this study was to investigate changes in the COP(center of pressure). The participants in this experiment were 5 elderly people, each of which was asked to descend staircases of three different heights (8cm, 16cm, and 32cm). As they climbed down the stairs, they received vibration stimulation on the ankle joint. The change of COP was analyzed during the stance phase. The COP differed according to vibration stimulation conditions. These results mean that COPRMS, COP pathway and COP area were influenced by the vibration on the ankle joint as the participants descended the stairs. It was concluded that the vibration stimulation on the ankle joint allowed the participants to efficiently climb down the stairs.

**U-Health, eHealth Technology**

**P2-55 심탄도 신호에 근거한 무구속 수면 모니터링 기법 개발**

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PSG is the gold standard for a sleep monitoring system. However, PSG is demanded specially trained sleep experts, long set up time, and high cost. Therefore, in this study, we proposed the nonintrusive sleep monitoring system based on BCG signals. BCG signals were collected non-intrusively by a load-cell-installed bed and classified into two stages: light and deep sleep. Support vector machine (SVM) was applied to light/deep sleep classification and 2-fold cross validation was used. SDNN and nHF were used as the features of the SVM and SVM showed the best classification result when using polynomial kernel.

**P2-56 자동보정기능이 추가된 고속 임피던스 단층영상 시스템**

손종표, 유필중, 위헌, 김현지, 오동인, 우응제

경희대학교 생체공학공과

임피던스영상신기술 연구센터

Electrical impedance tomography (EIT) can produce real-time images of conductivity variations associated with physiological changes inside the body. Multi-channel, multi-frequency EIT systems require a careful calibration to minimize systematic errors. Current source and voltmeter calibrations in a conventional EIT system are cumbersome. Since proper calibrations improve measurement accuracy, it is desirable to adopt it in a clinical EIT system. In this paper, we describe the design of a new EIT system with self-calibrations of multiple independent current sources and voltmeters. It produced images of cardiac events as well as slow respiratory events with better SNRs and event synchronization when operating with a customized ECG and respiration monitor.

**P2-57 u-Healthcare 기반의 스마트폰을 이용한 신체활동 에너지 측정 시스템 설계 및 개발**

김도윤<sup>1</sup>, 정해정<sup>1</sup>, 전소혜<sup>1</sup>, 안서영<sup>1</sup>, 강승용<sup>1</sup>, 배윤형<sup>1</sup>, 장병철<sup>2</sup>, 김남현<sup>1</sup>

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In clinical and population-based research, measuring

physical activity is necessary because it is a behavioral factor that plays a critical role in energy balance and in the etiology and prevention of chronic disease. Precise information about physical activity is also needed to estimate the energy expenditure of measured activities. The purpose of this study was to implement our previously established methods for estimating physical activity using a smartphone. We hope to use this system under free-living conditions.

#### P2-58 운동중 가속도 기반의 에너지 소비 추정

김주한, 조성필, 이희영, 이정훈, 김영호, 이경중  
연세대학교 의공학과

In this paper, we have proposed an energy expenditure method by using the accelerometer. Most studies adopted waist-placement because of the fact that the waist is close to the center of mass of a whole human body. But, we have adopted pocket-placement, which is capable of using unfixed axis of sensor that more reflects the daily activity condition than conventional methods. To evaluate the proposed method, 25 male subjects performed walk and running on a motor driven treadmill. All of subject put on the indirect calorimeter and the accelerometer simultaneously during exercise. The regression analysis was performed. A strong linear relationship between energy expenditure and accelerometer signal was found ( $r=0.9520 \pm 0.005$ ). By using this method, we can estimate energy expenditure unconsciously during the exercise.

#### P2-59 노인들을 위한 스마트폰 기반의 낙상 검출 시스템

심수영<sup>1</sup>, 전호선<sup>1</sup>, 정기성<sup>1</sup>, 김상경<sup>1</sup>, 권성준<sup>1</sup>, 박광석<sup>2</sup>  
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Recently, owing to the development of medical science and the increasing number of smartphone users in the elderly, 'smartphone-based senior-friendly medical products' are actively developed. And fall can result in major physical and psychological problems in the elderly. Therefore, in this study, various types of fall are detected using smartphone-based fall detection system including 3-axis accelerometer and fall detection algorithm.

#### P2-60 스마트 변좌 및 안드로이드 폰을 이용한 무구속 ECG 측정 및 모니터링

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Bowel movement is periodic and frequent in daily life and

it is very important biological activity. However, the patient who has a cardiac disorder should be required to give attention to the biological activity. Electrocardiogram (ECG) signal is very useful biomedical signal to evaluate the status of the patient. Monitoring the ECG signal of the patient during the bowel movement can provide understanding the current status of the patient as well as emergency detection. In this paper, we propose the non-invasive ECG monitoring system based on a smart toilet seat and a smartphone. The flexible capacitive electrodes on the smart toilet seat enable the system to measure the ECG signal non-constrainedly. The monitoring application for Android smartphone receives ECG data from the toilet seat and calculates heart rate in real-time using digital filter and peak detection algorithm we implemented. The system can be a practical example for the future ubiquitous medical services.

#### P2-61 머리전달함수를 반영한 디지털 보청기용 방향성 기술 개발에 대한 고찰

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<sup>3</sup>인하대학교 전자공학과

<sup>4</sup>삼성종합기술원 바이오헬스연구실

Directional microphones help hearing aid users with their efficient noise reduction performance. However, hearing aids are worn by people on their ears and affected by head shadow. Under the head shadow effect, the directionalities of directional microphones are steered and distorted to the opposite direction from the head. Therefore, before being applied to the hearing aids, directional microphones should be tested their responses whether they maintain directionality. In this study, we simulated the responses of first and second order directional microphones which are set to look forward considering head shadow using MATLAB. In free field situation the responses were symmetrical and sensitive to forward, while showed distorted but proper directionality when there head shadow existed.

#### P2-62 난청시물레이터를 통한 보청기 알고리즘 평가의 유용성

김희평<sup>1</sup>, 한종희<sup>1</sup>, 홍성화<sup>2</sup>, 이상민<sup>3</sup>, 김동욱<sup>4</sup>, 김인영<sup>1</sup>,  
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The accurate method for evaluation of digital hearing aid



algorithm is through subjective test with hearing loss impaired. But, it is costly and time-consuming. For this reason, we used hearing loss simulator (HLS). HLS is similar to the role of the hearing loss. This paper reports on the usefulness of HLS in evaluation of digital hearing aid algorithm. Detailed objectives are as follows: 1) Compared with hearing loss impaired, usefulness of HLS in subjective evaluation (Speech Quality-MOS, Speech intelligibility-SRT) of digital hearing aid algorithm with normal hearing person, 2) Correlation of several objective measures with value of subjective measures of hearing loss impaired.

#### P2-63 뎀스영상의 R-변환을 이용한 행위 인식

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This paper presents a human activity recognition (HAR) system utilizing depth silhouettes and R transformation. In this work, 2D directional projection maps are computed via Radon transform, and then 1D feature profiles are computed through R transform. Then, we apply Principle Component Analysis and Linear Discriminant Analysis to extract prominent activity features. Finally, Hidden Markov Models are used to train and recognize daily home activities. Our results show the mean recognition rate of 96.55% over ten typical home activities.

#### P2-64 의사결정 트리를 이용한 환경잡음 분류

서상완<sup>1</sup>, 한종희<sup>1</sup>, 육순현<sup>1</sup>, 이준창<sup>1</sup>, 박대규<sup>1</sup>,  
홍성화<sup>2</sup>, 이상민<sup>3</sup>, 김동욱<sup>4</sup>, 김인영<sup>1</sup>, 김선일<sup>1</sup>  
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<sup>4</sup>삼성중합기술원바이오헬스연구실

The hearing aid uses the classification algorithm and in order to adapt to the environment it has to use the algorithm fitted for the environment according to the environment changing rapidly. Accordingly, when applying to the noise environment which environment feature extraction and changes rapidly, then it makes. This experiment by using ZCR, STE feature extraction from the time domain frequency domain Spectral flux feature extraction. By using the Decision tree of WEKA, the environment was classified the speech, speech in noise, noise music by and the accuracy about this was confirmed.

#### P2-65 3차원 동적 자세균형기기를 이용한 균형 능력 향상 효과 분석

신선혜<sup>1</sup>, 이정원<sup>1</sup>, 김재준<sup>1</sup>, 임윤호<sup>2</sup>, 정구영<sup>2</sup>, 이선연<sup>3</sup>,  
고명환<sup>4</sup>, 권대규<sup>2</sup>  
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<sup>3</sup>전북대학교 임상시험센터  
<sup>4</sup>전북대학교 재활의학과

We performed experimental studies on the evaluation of balance ability using 3-D dynamic postural control system. Therefore we perform the experimental studies on effect of body with Space Balance 3D. 24 younger volunteers took part in a series of balance training using this system. Training was performed for 15 minutes a day, three times per week. To evaluate the effects of the training, such as the transfer limits of the different directions of eight and the sway path of center of pressure pre-training and post-training were measured. Also, Space Balance 3D was to demonstrate the effectiveness of the exercise by Balance System SD. Respectively, that training system with Space Balance 3D could successfully assess the gradual improvement of the dynamic postural control capability of the volunteers and showed improving balance capability of the volunteers.

#### P2-66 로잉운동의 부하편차 운동프로그램에 대한 인체영향평가

강승록<sup>1</sup>, 서신배<sup>2</sup>, 정구영<sup>5</sup>, 문동인<sup>3</sup>, 서영범<sup>4</sup>, 정장식<sup>4</sup>,  
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<sup>3</sup>전라북도 체육회 스포츠과학센터  
<sup>4</sup>㈜휴모닉  
<sup>5</sup>전북대학교 바이오메디컬공학부

The purpose of this study was to verify the validation of exercise loading deviation types during rowing exercise. We recruited twenty four subjects who have more muscle strength than average one in 20%. Subjects divide two group. one is dominant upper limbs (DU) the other is dominant lower limbs (DL). Subjects performed rowing exercise using electric equipment (Dr.gym .Humonic.korea). Measurement consist of evaluation of based physical fitness and joint torque using biodex (biodex system3..USA). The results have shown that the difference of maximal peak torque were getting decrease significantly during exercise. Also difference of various factor in based physical fitness were getting decrease significantly except flexibility and agility Our study found out that loading deviation could provide muscle strength and muscular endurance exercise for improving muscle unbalance.

#### P2-67 스마트폰 가속도계를 이용한 수면중 심박수 추출에 관한 연구

이정수<sup>1</sup>, 정기성<sup>1</sup>, 황수환<sup>1</sup>, 이소진<sup>2</sup>, 정도연<sup>2</sup>, 박광석<sup>3</sup>

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<sup>3</sup>서울대학교 의과대학 의공학교실

In this study, we examined the possibility of extracting heart rate using the smartphone accelerometer during sleep. To examine, we developed a smartphone application which can monitor the values of 3-axis accelerometer of the smartphone. Three subjects were participated in this study and the smartphone was placed on their chest with Velcro belt. Heart rates were extracted from the acquired signals with simple peak detection algorithm. We could find that the extracted heart rates from the z-axis of the accelerometer were highly correlated with from conventional electrocardiogram. This study is promising to measure the heart rate of smartphone users whenever wherever they want.

#### P2-68 힙판을 이용한 자세균형 훈련기기의 평형감각 효과분석

이정원<sup>1</sup>, 신선휘<sup>1</sup>, 김재준<sup>1</sup>, 정구영<sup>2</sup>, 이선연<sup>3</sup>, 고명환<sup>4</sup>, 권대규<sup>2</sup>

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<sup>2</sup>전북대학교 바이오메디컬공학부

<sup>3</sup>전북대학교 임상시험센터

<sup>4</sup>전북대학교 재활의학과

This paper investigated the effect of postural balance training system using force plate. The integration of vestibular, visual, and somatosensory information is very important to postural balance. Especially muscular strength is essential in maintaining the postural balance. Force plate is generally used to evaluate the balance and to improve equilibrium sense. IBalance is newly designed balance training system using force plate and include various balances training program. Therefore we perform the experimental studies on effect of body with IBalance. Human effects of 4 week training with IBalance. 12 people participated in the experiment and it was performed for 15 minutes a day, three times per week. We compare improvement of postural capability of IBalance with Balance system SD. The experimental results showed that subjects improve the capability of balance.

#### P2-69 디지털 PWM 방식 드라이브 회로 기반의 액추에이터 구동 및 성능평가

김상훈, 최우혁, 김태균, 신태민

연세대학교 보건과학대학 의공학과

This study proposed that the high efficient and compact

driving circuit can be designed through the method of digital PWM drive. Thus it can overcome problems with existing sonicwave whole body vibration equipment using analog drive circuit. In addition, when the actuator of SWBV is driven by the method of digital PWM, the appropriate vibration for the purpose can be accurately generated. Because the method suggested in this paper can generate the frequency of vibration as well as control the vibration frequency precisely compared to conventional method. Moreover SWBV based on digital PWM drive circuit can lead to various forms.

#### P2-70 전신진동과 유연성운동에 대한 시너지효과분석

강승록<sup>1</sup>, 서신배<sup>2</sup>, 정구영<sup>5</sup>, 문동안<sup>3</sup>, 민진영<sup>4</sup>, 김정자<sup>5</sup>, 권대규<sup>5</sup>

<sup>1</sup>전북대학교 대학원 헬스케어공학과

<sup>2</sup>전북대학교 생체정보공학부

<sup>3</sup>전라북도 체육회 스포츠과학센터

<sup>4</sup>(주)터보소닉

<sup>5</sup>전북대학교 바이오메디컬공학부

This study is to analyze the synergy effect between whole body vibration exercise and flexibility exercise. Subjects are all 40 people and they have no experience of exercise, also no medical history with injury of exercise. Subject are divided between provided flexibility exercise& whole body vibration and only provided flexibility exercise. Experiment has been progressing for 4-weeks, we measured trunk flexion forward and trunk extension backward before and after exercise for comparing effect of flexibility. The results have shown that in whole body vibration&flexibility group there bigger variation of trunk flexion forward and trunk extension backward. We indicated that whole body vibration could provide bigger effect of exercise because that whole body vibration has stimulated muscles related flexibility, that makes tonus of muscle keep continuously and caused bigger muscular activity.

#### P2-71 전력선통신을 이용한 체표면통신 시뮬레이션

박철희, 최우혁, 김태균, 신태민

연세대학교 보건과학대학 의공학과

This study is aimed to implement the Skin Based Communication (SBC) using Power Line Communication (PLC). SBC based on PLC has simple circuit configuration and is easy to control. In addition SBC has the advantage of being 1:N communication because it is comfortable to extend the network layer. In this paper, data communication was well in Phantom. It is possible that data communication based on SBC using PLC is well in Phantom. Consequently, it seems to be applicable to medical devices which communicate bio signals measured from body to the main control through skin.

P2-72 **가속도계와 각속도계를 이용한 사람의 방향별 낙상 인식**

임명준, 조진호, 조영선, 김태성  
경희대학교 생체의공학과

Human fall in the elderly population is one of the major causes of various injuries. Various algorithms have been devised to detect human fall, but these algorithms cannot recognize directional falls. In this study, we propose a fall recognition algorithm using a pair of tri-axial accelerometer and gyroscope sensors. In recognition, a set of augmented feature vector is utilized including autoregressive coefficients (AR coefficients), signal magnitude area (SMA) and gradients of gyro angles from the sensors. After linear discriminant analysis (LDA) of the augmented features, artificial neural nets (ANNs) are utilized to recognize directional falls. Our recognition results show the mean recognition rate of 95.8%.



2011년도 제43회 대한의용생체공학회 춘계학술대회

## POSTERS III



KOSOMBE



### P3-01 근적외선 혈류동역학적 변화와 뇌전도 신호의 동시 측정에 의한 후각 신경신호 분석

신재우<sup>1</sup>, 고진수<sup>1</sup>, 이현주<sup>1</sup>, 임창균<sup>1</sup>, 박재홍<sup>1</sup>, 서인석<sup>1</sup>  
김기성<sup>2</sup>, 신형철<sup>1</sup>

<sup>1</sup>한림대학교 의학과 생리학교실

<sup>2</sup>락싸기술연구소

The electroencephalography (EEG) recording has been used brain signal non-invasively for a long time. Recently, the hemodynamic change recorded by near infrared spectroscopy (NIRS) is introduced for non-invasive monitoring of brain signals. In this study, we simultaneously recorded the NIRS-based hemodynamic changes (ISS Imagent, USA) and EEG (LXE3208, Laxtha, Korea) activities from anesthetized rats. The signal acquisition was done during presentation of either blank or two odorants (Isopropylbenzene, 2-Heptanone) stimuli in sequence in front of rat nose. The target area was the main olfactory bulb for NIRS signals and the cerebral cortex for EEG. We found the presence of statistical significance between two (NIRS and EEG) signals evoked by olfactory stimulations.

### P3-02 Spectrometer를 사용한 Pulse Oximeter용 SpO<sub>2</sub> Simulator의 구현

나재석, 전아영, 유주연, 박근철, 노정훈, 전계록

부산대학교 의공학교실

The innovative SpO<sub>2</sub> simulator was implemented. Pulse oximetry is one of the real-time SpO<sub>2</sub> monitoring methods. SpO<sub>2</sub> simulator is able to verify pulse oximeters by testing them in a variety of ways. However, these SpO<sub>2</sub> simulators can test limited pulse oximeter because of different wavelengths according to various pulse oximeters respectively. In the study, universal SpO<sub>2</sub> simulator according to characteristic of wavelength was implemented by measuring wavelength of red and infrared LED embedded in pulse oximeter with spectrometer.

### P3-03 이동 촬영용 X선 기기의 제어회로 개발

김영표<sup>1</sup>, 김태곤<sup>1</sup>, 천민우<sup>2</sup>, 이호식<sup>2</sup>, 박용필<sup>2</sup>

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Mobile X-ray equipment which is typically used in the mobile type of X-ray can be used very usefully beyond the space

restriction. However, due to its difficulty to generate high voltage, it is mainly applied to take hand and foot shootings which only need low output power. In this study, by designing and producing the large volume of mobile X-ray equipment which doesn't have the limitations on diagnostic areas of the body, the operating characteristics of equipment according to the loading change was identified. Also, the operation of tube voltage and tube current was controlled by using frequency modulation method and operation results were identified using oscilloscope.

### P3-04 광학집게를 이용한 유전영동력 측정

홍유찬<sup>1</sup>, 노광수<sup>2</sup>, 김법민<sup>3</sup>, 이상우<sup>1</sup>, 윤대성<sup>1</sup>

<sup>1</sup>연세대학교 의공학과

<sup>2</sup>KAIST 신소재공학과

<sup>3</sup>고려대학교 의공학과

The term 'dielectrophoresis (DEP)' was first introduced by Pohl in 1958 to describe the force induced by a non-uniform electric field on a small polarizable but uncharged particles. Time-periodic inhomogeneous electric fields induce polarization and subsequent movement of dielectric particles. On the other hand, optical tweezers due to its capability of measuring pico-newton order force has been applied to study mechanical force in biochemistry and biophysics. Up to date, the dielectric force has been calculated but not measured in many cases. In this paper, we will focus on experimental evaluation of dielectric force using optical tweezers.

### P3-05 광 신경신호 계측을 위한 광섬유 처리 기술

문효원, 김신애, 이성은, 김성준

서울대학교 전기컴퓨터공학부

We fabricated a pencil-shaped fiber probe that can be used in neuronal activity measurement. The probe was tapered with simple wet etching process to facilitate *in vivo* insertion. Insertion force to a rat brain was measured and it was demonstrated that our tapered probe was suitable for *in vivo* insertion compared with an untapered one. The pencil-shaped probe is expected to be applied to *in vivo* optical recording and stimulation systems.

## Cardiovascular Engineering

### P3-06 공기가압이 심혈관계에 미치는 영향

전아영<sup>1</sup>, 유주연<sup>1</sup>, 박근철<sup>1</sup>, 최병철<sup>2</sup>, 이승진<sup>3</sup>, 전계록<sup>1</sup>

<sup>1</sup>부산대학교 의공학교실

<sup>2</sup>춘해보건대학 의료공학과

<sup>3</sup>대성마리프

In the study, venous flow velocity and venous refilling time (VRT) were measured to investigate the influences of pneumatic compression on cardiovascular system. The venous flow velocity and VRT of 61 healthy subjects were measured at the inguinal area before pneumatic compression by using Accuvix V10 (Medison, Republic of Korea). The cuff was placed around the lower limbs, and the pneumatic compression was applied using DVT-2600 (Daesung MAREF, Republic of Korea). The maximum of venous velocity after pneumatic compression VRT was measured, and Mean Venous Velocity (MVV) before pneumatic compression was  $26.92 \pm 9.77 \text{ cm/s}$  and MVV after pneumatic compression was  $21.3 \text{ cm/s}$ . As a result, venous flow velocity was increased by approximately 45%. Mean value of VRT was  $30.52 \pm 11.53 \text{ s}$ .

### P3-07 태아 및 산모 감시 시스템

남기창<sup>1</sup>, 이다솜<sup>1,2</sup>, 이 전<sup>3</sup>, 이찬오<sup>4</sup>, 권자영<sup>5</sup>, 김덕원<sup>1,2</sup>

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<sup>3</sup>대구한의대학교 한방의공학과

<sup>4</sup>(주)비스토스

<sup>5</sup>연세대학교 의과대학 산부인과학교실

During pregnancy, continuous monitoring for fetal and maternal has demonstrated to reduce the incidence of prematurity and miscarriage. Therefore, it is necessary to monitor fetal and maternal simultaneously. Some major companies have released those function of the system, but there is no domestic. In this paper, we presents an outline and preliminary result of a combination system of fetal and maternal monitoring.

### P3-08 심실보조장치의 동기 박동 제어를 위하여 임피던스 방법을 이용한 심장박동 시기의 측정

김문수<sup>1</sup>, 최성욱<sup>1,2</sup>

<sup>1</sup>강원대학교 기계의공학학과

<sup>2</sup>의료·바이오신소재융복합연구사업단

In this study, the opening time of aortic valve will be measured

by using vascular impedance from the artery to the skin above ventricular muscle. To measure those impedance, we developed an impedance measuring system that can generate sinusoidal current (0.2mA, 30 kHz) and measure 0.1~1% impedance changes (at 500 ohm, 0.1~10 Hz). The measured data can be used to monitor the patient's heart conditions such as ventricular fibrillation, arrhythmia and cardiac output. During the pulsatile VAD perfusion, those can be used as important data to synchronize the VAD to the patient's heart and avoid co-pulsation.

### P3-09 절흔부위 위치 변화 양상을 이용한 혈압추정 방법

유주연, 박근철, 전아영, 박성민, 노정훈, 전계록

부산대학교 의공학교실

Available automatic blood pressure measurement devices using oscillometric method have different value of diastolic and systolic blood pressure because of different parameters. In the study, the more accurate blood pressure was estimated by using variation aspect of dicrotic notch region of the pulsating waveform of each cardiac period. And between the estimated blood pressure value using proposed method and the measured blood pressure value using electronic sphygmomano-meter had compared. As a result of study, the systolic blood pressure was  $-0.875 \text{ mmHg}$ , and the diastolic blood pressures was  $+1.875 \text{ mmHg}$  by subtracting the value of blood pressure using proposed method acquired from sphygmomano-meter using oscillometric method.

### P3-10 유한요소해석을 통한 스텐트 구조 검증과 전기방사를 이용한 약물방출스텐트 개발

신일균<sup>1</sup>, 김동곤<sup>1</sup>, 김한기<sup>1</sup>, 김은진<sup>1</sup>, 김상호<sup>1</sup>, 전동민<sup>2,3</sup>, 서태석<sup>2,3</sup>, 장홍석<sup>4</sup>

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<sup>2</sup>가톨릭대학교 의공학교실

<sup>3</sup>가톨릭대학교 생체의공학연구소

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Recently, along with technology development of endoscopic equipment, a stent has been developed for the convenience of operation, shortening of recovery times, and reduction of patient's pain. To this end, optimal factors are simulated for the stent structure and mechanical reaction and verified using finite element analysis. Also, paclitaxel eluting metal stents for treatment of biliary benign stenosis were developed by means of an electrospray-coating method. Polyether-based polyurethane (pellethane), PLGA and paclitaxel were coated onto the surface of a metallic



stent and a topcoat of PVP K-90 was used as a barrier to control drug release. Characterization of multi-layered film was analyzed by SEM, DSC, X-RAY, IR Spectrum.

**P3-11 광혈류량검사를 위한 DAQ 기반 시스템**

박종인, 김태형, 조성보

가천의과학대학교 의공학과

Photo-plethysmography (PPG) is simple and low cost method to monitor and analyze the change in the blood volume. In this paper, it was investigated whether PPG by using DAQ (Data acquisition) and LabVIEW can be used to improve the portability and accuracy of PPG. The experimental results demonstrated that DAQ and LabVIEW based system can be utilized to monitor and detect the blood pulses for PPG.

**P3-12 심전도 검출 및 분석을 위한 DAQ 기반 시스템**

진주영, 김태형, 조성보

가천의과학대학교 의공학과

Electro Cardio Graphy (ECG) is used to measure the bioelectricity caused by the heart activity and to diagnose the cardiovascular diseases. In this paper, we designed an Electro Cardio Graphy using DAQ (data acquisition) and LabVIEW for signal processing of raw ECG instead of using the typical analog circuit of amplification, filter or pulse detection. The experimental results showed that DAQ and LabVIEW based ECG can be utilized to monitor and to detect the heart pulses.

**Medical and Bioinformatics**

**P3-13 베이지안 빌리프 네트워크를 이용한 연령군별 유방암의 조기 진단에 관한 기초 연구**

이치원<sup>1</sup>, 김유단<sup>1</sup>, 임민혁<sup>2</sup>, 김성완<sup>2</sup>, 박보영<sup>2</sup>, 박수경<sup>2</sup>

<sup>1</sup>서울대학교 공과대학

<sup>2</sup>서울대학교 의과대학

A Bayesian Belief Network is a powerful framework in dealing with complexity and uncertainty. There are many risk factors involved in disease occurrence that have complex relationships between variables. In this study, a Bayesian Belief Network for early diagnosis of Breast Cancer by age group is developed. The model could predict a probability of breast cancer occurrence for an individual as age group with specific risk factors and the model could also show the characteristics of population that could be used in epidemiological study. Furthermore, the model will support physicians' final decision making process. The outcomes of this research could be applicable to various areas of medicine.

**P3-14 Dry 전극시스템을 이용한 경혈의 전기적 특성해석**

김민수<sup>1</sup>, 조영창<sup>2</sup>, 서석태<sup>1</sup>, 손창식<sup>3</sup>, 박희준<sup>4</sup>, 김윤년<sup>4,5</sup>

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<sup>4</sup>계명대 의공학과

<sup>4,5</sup>동산의료원 심장내과

The skin electrical resistance at BAPs and non-BAPs were examined with modified electrode system for healthy male subjects. Bio-impedance was then conducted for the BAPs and Non-BAPS using a lock-in amplifier with a frequency range of 1 Hz -1.2 kHz. The resistances of four BAPs were found to decrease to about 29-59% of the non-BAPs and reactance of BAPs were found to decrease to about 23-41% of the non-BAPs. The difference in electrical impedance between BAPs and non-BAPs was easily recognized since the average value of BAPs was measured lower values than that of non-BAPs. Through these experiment, BAPs could be distinguished from non-BAPs based on the electrical impedance.

### P3-15 회귀분석과 의사결정트리를 기반으로 한 급성 충수염 진단을 위한 의사결정모형

손창식<sup>1</sup>, 서석태<sup>2</sup>, 김민수<sup>2</sup>, 정선주<sup>2</sup>, 박희준<sup>3</sup>, 장병국<sup>4</sup>,  
조윤경<sup>5</sup>, 김윤년<sup>3,5</sup>

<sup>1</sup>계명대 의과대학 의료정보학교실

<sup>2</sup>계명대 생체정보기술개발사업단

<sup>3</sup>계명대 의과대학 의공학과의

<sup>4</sup>동산의료원 소화기내과

<sup>5</sup>동산의료원 심장내과

The correct diagnosis of acute appendicitis disease among patients visiting emergency department (ED) with abdominal pain is very important, but difficult. In this study, we developed a decision support model, based on regression analysis and decision tree algorithm, to diagnose between non-appendicitis and appendicitis disease groups. To show its applicability in the (differential) diagnosis problem, we have applied it to select the relevant items and construct a decision support model from the collected clinical raw data.

### P3-16 심전도와 적응 잡음 제거기를 이용한 심음의 향상법

김필운<sup>1</sup>, 이윤정<sup>1</sup>, 조진호<sup>3</sup>, 김명남<sup>2</sup>

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<sup>3</sup>경북대학교 IT대학 전자공학부

Auscultation sounds consist of sounds occurred inside of body. In this paper, we proposed heart sounds enhancement method by an adaptive noise canceller based on ECG. The new reference sounds were generated from the original auscultation sounds by using ECG and heart sound profile. And they were applied to adaptation of noise canceller. By experimental results, we confirmed that the proposed method efficiently reduces noises and enhances heart sounds.

### P3-17 에너지소모량센싱 기술을 이용한 복합 혈당관리 시스템

고현철<sup>1</sup>, 이승환<sup>1</sup>, 박재현<sup>1</sup>, 엄재학<sup>2</sup>, 윤영로<sup>1</sup>

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<sup>2</sup>동진메디칼

In this paper, we suggest that management system to expect blood glucose levels. Parameters that affect blood sugar are food, drugs, BMR (basal metabolic rate), exercise consumption. Designed device count of increased glucose

level and exercise consumption. And we developed PC software that manages all about measured data and calculated.

### P3-18 대표적 소아 족부 질환에 대한 생체역학적 보행특성 분석

김진호<sup>1</sup>, 권대규<sup>2</sup>, 김동욱<sup>2</sup>, 김정자<sup>2</sup>

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<sup>2</sup>전북대학교 공과대학 바이오메디컬 공학부

Flat feet is a formal reference to a medical condition in which the arch of the foot collapses. The appearance of flat feet is normal and common in infants. It has been known to cause additional foot problems such as achilles tendonitis, scoliosis and in-toe gait. In this research, 14 feet of 7 young children who were confirmed as patients having flat feet, achilles tendonitis, scoliosis and in-toe gait by podiatric expert in pediatrics, and the analysis of biomechanical gait characteristic using the EMG data and ankle angle measured by 6-dof inertial measurement system.

### P3-19 노인의 발목관절 ROM과 하지 근육 활성 패턴에 따른 보행 특성 평가

정지용<sup>1</sup>, 권대규<sup>2</sup>, 김동욱<sup>2</sup>, 김정자<sup>2</sup>

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<sup>2</sup>전북대학교 공과대학 바이오메디컬공학부

This study was to assess gait characteristic of elderly people by measuring ankle joint range of motion (ROM) and lower extremity muscle activity. 13 healthy older adults (age  $70 \pm 4$ ) wore the inertia sensor on both ankles and walked on Gait Trainer treadmill (BIODEX, USA), and EMG activity of lower limb such as rectus femoris, biceps femoris, tibialis anterior, gastrocnemius medial head was measured during gait. Elderly people exhibited greater muscle activity in gastrocnemius medial head with increased ankle plantarflexion. Also, ankle joint ROM and EMG patterns are changed according to the gait cycle as stance phase and swing phase.

## Medical Imaging

### P3-20 적외선 안구영상에 대한 곡률 알고리즘 기반의 눈동자 검출

최우혁, 류문학, 김태균, 신태민  
연세대학교 보건과학대학 의공학과

In order to accurately track the eye movement during SPEM, specific pupil detection algorithm is required. In this paper, the pupil image was obtained using infrared sensor. After then the curvature algorithm applied to the infrared pupil image. As a result, the mid-point of subjects' pupil is detected. The results from a pupil detection algorithm suggested in this paper show that the pupil on SPEM system can be accurately detected in real-time.

### P3-21 3차원 레이저 스캐너를 이용한 CT 영상의 Markerless Registration

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Surgical navigation systems represent a surgical concept, that use computer technology for surgical planning and performing surgical interventions. Optical tracking markers usually use the navigation system for tracking the location of the surgery. However, optical tracking makers get in the way of surgery because it exists on the surgical region. 3D laser scanners can be used for registration without an optical tracking marker. Surface was generated from the computed tomography (CT) from skull phantom. Registration was performed using iterative closet point (ICP) algorithm. Point to point registration was used for stereo camera to 3D laser scanner registration.

### P3-22 ITO (Indium Tin Oxide)전극기판 종류에 따른 광도전체 전기적 특성변화 연구

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The research which sees special solvent binder and mixed

commercialized photoconductor powder at schedule ratio. X-ray films were made Screen Printing method. ITO glass electrode boards of 1200um thickness which is used in existing and ITO glass of 500um thickness which is produced specially and Flexible ITO electrode where is produced with Roll-to-Roll sputtering system evaluated the electric and structural quality which follows in thickness and type. Aim of this dissertation is a production of ITO electrode boards which react with X-ray conversion materials of high efficiency.

### P3-23 초음파 배열형 트랜스듀서 구동을 위한 양극성 펄서 연구

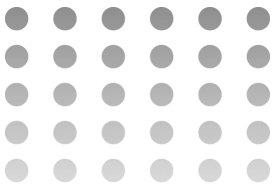
유희일, 박동희, 박진감, 고유미, Saad, 문상협, 서종범  
연세대학교 의공학과

This study presents a simple bipolar pulser for driving ultrasound array transducer. It has been successfully tested at the 200 Vpp having pulse duration of 400 ns. The higher voltage and faster switching allows this pulser to be very useful for ultrasound transducers in practical applications. The pulser consists of two MOSFET drivers (EL7158) and a MOSFET pair (TC6320). Small size of the components allows miniature scale design. The pulser was controlled by using a computer. The pulser was programmed to generate bipolar pulse trains with 10 cycles, at frequency of 2.5MHz and amplitude of 200Vpp. Experimental measurements are presented.

### P3-24 구조화된 섬광체 내부의 반사코팅을 이용한 X-ray CIS 광 효율 개선 시뮬레이션

김명수, 배준형, 김종열, 김형택, 강동욱, 이대희, 유현준, 조민식, 김현덕, 조규성  
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In an indirect X-ray detector, not only CMOS image Sensor performance but also scintillator efficiency is important to get a high quality X-ray image. Especially, system resolution and light transfer efficiency depend on the structure of scintillator. A guided structure scintillator is good for high resolution. However, the light transfer efficiency is poor because this structure has relatively low amount of scintillation materials and loss of wall effect. In this study, we laminated inside of this structure with some kinds of reflection materials in order to obtain the optimization condition of the high transfer efficiency, and found out high efficiency materials and some effects by simulations.



## P3-25 광 음향 영상 시스템: 구현 및 예비 결과

진성민, 조한진, 전강원, 강지운, 유양모, 송태경  
서강대학교 전자공학과

In this paper, a recently-developed prototype photo-acoustic imaging system is presented. In the photo-acoustic imaging system, to acquire photoacoustic signals, a commercial ultrasound imaging system equipped with a research package is connected with a laser excitation system via cascaded function generators. To evaluate the performance of the developed photoacoustic imaging system, phantom experiments were conducted with a graphite lead (3 mm and 0.5 mm of length and diameter, respectively.) insulated in a plastic phantom. From the phantom experiment, the reconstructed photoacoustic image shows the enhanced sensitivity for detecting the target while providing a lower resolution compared to a conventional ultrasound image due to one-way focusing (i.e., 0.7 mm and 1.4 mm for ultrasound and photoacoustic imaging, respectively).

## P3-26 광 음향 영상을 위한 공간 평균 Coherence Factor 기반 적응 수신 빔 집속 기법

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In photoacoustic imaging, it is challenging to improve spatial resolution and signal-to-noise ratio (SNR) since the excited laser is broaden in soft tissue and one-way dynamic receive focusing is solely conducted. In this paper, we propose the spatially-smoothed coherence factor based adaptive receive beamforming method (ABF-SSCF) for photoacoustic imaging to simultaneously improve its resolution and SNR. From phantom experiments, it has been learned that the ABF-SSCF provides comparable spatial resolution compared to the previously-proposed coherence factor based adaptive beamforming method (ABF-CF) (1.8 mm and 1.9 mm for ABF-CF and ABF-SSCF, respectively) while potentially avoiding image distortions.

## P3-27 세 쌍 컴프턴 카메라의 해상도 복원용 재구성을 위한 공간변형 점퍼점함수 측정 방법

김수미<sup>1,2</sup>, 이재성<sup>1,2</sup>, 서희<sup>3</sup>, 박진형<sup>3</sup>, 김찬형<sup>3</sup>, 이춘식<sup>4</sup>, 이명철<sup>1</sup>, 이동수<sup>1</sup>, 이수진<sup>5</sup>

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<sup>2</sup>서울의과대학 의학연구원 방사선의학연구소

<sup>3</sup>한양대학교 원자력공학과

<sup>4</sup>중앙대학교 물리학과

<sup>5</sup>배재대학교 전자공학과

In the Compton camera, the spatial resolution is deteriorated because of the measurement uncertainties of the detected positions and energies in the detectors. We reported the OSEM (ordered subset expectation maximization) reconstruction algorithm, in which the point spread function of the Compton camera was incorporated into the system model, to recover the resolution. In this study, we propose a strategy on estimating the shift-variant point spread function (SV-PSF) over the field-of-view using point sources for three pair of the Compton camera. The listmode OSEM (LMOSEM) incorporating the SV-PSF were performed and then compared with OSEM without resolution recovery model and with shift-variant PSF.

## P3-28 폐 및 간 영역의 정량적 개선을 위한 내부 움직임 평가

유정우<sup>1,3</sup>, 이상근<sup>1</sup>, 이용진<sup>1</sup>, 김진수<sup>1</sup>, 이교철<sup>1</sup>, 김민환<sup>1</sup>, 지영훈<sup>2</sup>, 강주현<sup>1</sup>, 김병일<sup>1</sup>, 최창운<sup>1</sup>, 임상무<sup>1</sup>, 정용현<sup>3</sup>, 김경민<sup>1</sup>

<sup>1</sup>한국원자력의학원 방사선의학연구소 분자영상연구부

<sup>2</sup>방사선암연구부

<sup>3</sup>연세대학교 방사선학과

The purpose of this study was to estimate the optimal gates number for tumor localization using estimated internal motion. Internal motion has been demonstrated in small animal lung region by coated molecular sieve. Rat PET images were obtained at 60 min post injection of FDG. Breathing signals were collected and converted to trigger signals. In PET image analysis, count and SNR were drawn in the target region. The motion compensation PET image for optimal gate number was confirmed by FWHM. The internal motion estimation will be a useful method for motion prediction modeling of internal organ motion.

## P3-29 자기공명 자화율 강조 영상을 이용한 정상인 뇌의 기저핵 볼륨측정

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<sup>4</sup>인제대학교 FIRST 연구단

The purpose of this study is to estimate the volume of basal ganglia including caudate nucleus, globus pallidus, and putamen using SWI method instead of conventional T1 based volumetric analysis. In order to examine its usefulness, 5 normal volunteer was recruited. From the quantitative results, we suggest that volumetry using SWI technique can

provide quantitative and visual outcome by measuring the ROI pattern for the patients with parkinson variant of multiple system atrophy (MSA-p) which has specific characteristics such as iron deposition. Additionally to optimize the results, we will devise the objective index to volumetry through various SWI sequences in future study.

#### P3-30 자기공명장치에 따른 3D 뇌 분할 체적 비교

정원범<sup>1</sup>, 한용희<sup>1</sup>, 장무영<sup>1</sup>, 곽소영<sup>1</sup>, 문치웅<sup>1,2</sup>

<sup>1</sup>인제대학교 의용공학과

<sup>2</sup>인제대학교 UHRC/FIRST

Brain volumetry is non-invasive and automated method used to detect the eventual volume loss of the brain specific region by quantifying the volume size. In this study, we investigated the inter-scanner variability of an automated method for brain volumetry and measured the quantitative size of gray matter, white matter and cerebrospinal fluid about the MR images acquired from the different 3 type MR scanners at single person. It was confirmed that the similar voxels size about segmented results were derived from 3 MR scanners and that the optimized brain templates were needed to perform correct volumetry for specific regions.

#### P3-31 다양한 자기공명장치에 대한 뇌 영상의 해마 체적 분석

정원범<sup>1</sup>, 한용희<sup>1</sup>, 강복만<sup>1</sup>, 김영훈<sup>2</sup>, 이영민<sup>3</sup>, 문치웅<sup>1,4</sup>

<sup>1</sup>인제대학교 의용공학과

<sup>2</sup>해운대 백병원 정신과

<sup>3</sup>부산대학교병원 정신과

<sup>4</sup>인제대학교 UHRC/FIRST

Alzheimer's disease diagnosis using MR imaging have been investigated. Alzheimer's disease is known for atrophy of hippocampus in brain. In this study, we tried to determine the significance of access as analysis specific region repeatedly in one normal subject before analyzing the specific disease groups. MR Images which normal to target subject were acquired in the three kinds of MR scanners. The hippocampus volumes acquired images were measured visually and quantitatively by conducting volumetry using 3D-rendering.

#### P3-32 탄성영상법을 위한 실험용 초음파 시스템 개발

한지혜, 김동인, 조민형, 이수열

경희대학교 생체의공학과

Elastography is the method to detect cancer tissue

surrounding the normal tissue. However there are too many limits to get elastography image by using clinical ultrasound system. It is essential to control pulse sequence and pulse duration when we get elastography image. This paper introduces new platform which allow us to control pulse sequence, pulse duration, and pulse amplitude of the wave.

#### P3-33 수치 팬텀 실험을 통한 MR 정맥 조영도 최적화 연구

신석현, 장웅, 황도식

연세대학교 전기전자공학과

MR Venography acquired from minimum intensity projection (mIP) is useful to diagnose vessel anomaly in the brain. mIP image has low contrast between vessel and tissue. It may cause a wrong diagnosis in clinical area. Moreover, it may result serious damage to the body during surgery. To solve this problem contrast should be high enough to distinguish vessel with tissue.

#### P3-34 적외선 열화상기술을 이용한 자성 나노입자의 열분포 측정기술

김재영, 국명호, 최해룡, 유선영, 김기석, 김건희, 장기수

한국기초과학지원연구원 연구장비개발부

This research develops noncontact, safe, deep penetration, and low-cost infrared (3~5 $\mu$ m spectral range : mid infrared) imaging technique that would improve upon current methods using magnetic nanoparticle based imaging. Experiments were performed using an in vitro tissue model, an radio frequency heating system, and an infrared camera. As a result, highly-sensitive infrared thermography can tumor phantom (50nm size nano-particle-Fe<sub>3</sub>O<sub>4</sub>) be detected by lock in technology.

## Neural Engineering

### P3-35 인공 시각에서 얼굴 인식에 대한 휘도대비 강조의 효과

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With successes in neural prosthesis, many research team have investigated a visual prosthesis to get vision back to the blind. Applying image processing techniques is one of the current issues to make visual information richer. In this study, we experimented facial recognition with a different number of pixels using contrast enhancement technique. Facial images were presented as 12×12 or 16×16 pixels to mimic phosphenes. As a result, subjects showed better performances considering both accuracy and correct response time only with 16×16 images.

### P3-36 용량성 결합을 이용한 뇌파 측정 가능성 탐구

백현재<sup>1</sup>, 이홍지<sup>1</sup>, 임용규<sup>2</sup>, 박광석<sup>3</sup>

<sup>1</sup>서울대학교 협동과정 바이오엔지니어링 전공

<sup>2</sup>상지대학교 한방의료공학과

<sup>3</sup>서울대학교 의과대학 의공학교실

For the purpose of zero-preparation measurement of electroencephalogram for real-world practical applications, capacitive measurement method that does not require direct skin-to-sensor contact was presented. Measurement was made using active electrode utilized high input impedance with some bias current network methods and shielding methods. Comparison between conventional Ag/AgCl electrode and proposed electrode showed comparable performance in simulated EEG signal acquisition. Also, clear alpha activity was monitored at Oz region using capacitive coupled electrode when subject closed their eyes. This study shows the feasibility of the method for zero-preparation measurement of electroencephalogram.

### P3-37 다채널 미세전극칩의 임피던스 조절 및 분석을 위한 시스템 구축

김래영, 남윤기

KAIST 바이오 및 뇌공학과

Planar-type microelectrode arrays (MEAs) have been used

to measure electrical signals from cultured neural networks. The impedance of an electrode should be sufficiently low to measure high quality signals and increase an efficiency of electrical stimulations. In this work, we developed an impedance control and analysis system that improved user interface convenience. We found optimal conditions and the procedure of platinum black electroplating for MEA by using the system. The impedance of electrodes dramatically declined after electroplating and the neural network on the MEA retain activity more than fifteen days.

### P3-38 백색질의 비등방성 전기 전도도와 차폐판이 TMS에 미치는 영향

조영선, 조진호, 임명준, 모하메드 킬라니, 김태성

경희대학교 생체공학학과

Transcranial magnetic stimulation (TMS) is a non-invasive technique for brain stimulation using the principle of electromagnetism to induce electric field in the brain via coils placed above the head. It has been used for a treatment of brain dysfunctions such as depression and epilepsy. For effective stimulation with TMS, spatial focality of induced electric field and realistic head model are important factors to be considered. In this study, we generate conductive shield plate to increase focality and realistic head model considering anisotropy. Our results show the anisotropy can have significant effect on the induced electric field and shield plate increases the focality with the reduced magnitude of electric field.

### P3-39 Liquid Crystal Polymer (LCP) 기반의 신경보철 장치를 위한 유연한 기판에의 Flip-chip 접합

김정태, 정준수, 민규식, 김성준

서울대학교 공과대학 전기 컴퓨터 공학부

Small size and flexibility are needed for neural prosthetic implants. For this purpose, the LCP substrates are increasingly being used. Mounting IC chips on this flexible polymer substrate can be challenging. In this paper, we present a method to package a chip on the flexible substrate and discuss the practicality of the method in applications such as retina prosthesis.

### P3-40 다채널미세전극칩을 이용한 체외 신경네트워크의 장기간 연속 신경신호측정 및 분석 시스템 구축

주성훈, 남윤기

KAIST 바이오및뇌공학과

This article introduces a system that is capable of measuring and analyzing multichannel neural activities from planer type microelectrode arrays continuously. Long-term and continuous measurement of neuronal signal is important in the analysis of development of electrical physiology phenomena in cultured neural network. However, long-term continuous recording has the following practical problems: osmolarity change, mechanical perturbation, temperature variation. To solve these problems, we developed a system that integrate CO2 incubator, temperature controller, and multichannel amplifier unit. Using this system, we successfully recorded developing neural activities from a cultured cortical neural network for 20 days. This system will be useful for understanding brain dynamics.

### P3-41 미세전극칩시스템용 3차원 나선형 전극

문진희, 차보환, 김정훈, 이상훈

고려대학교 보건과학대학 생체의공학과

Microelectrode array (MEA) system has improved neuronal-on-a-chip technology for study of network among neurons. But the result of research with MEA system is hard to be applied to clinics because of the difference between in vitro and in vivo. If the system could be used to the networks of 3D-cultured neurons, the result would be more accurate and could be applied to clinical studies. So, we developed 3D spiral micro-electrode array with biocompatible materials through MEMS technology.

### P3-42 ECoG 신호에서 ERD/ERS 패턴을 이용한 운동신호 분석

김태경<sup>1</sup>, 송수화<sup>2</sup>, 김진률<sup>2</sup>, 송인호<sup>2</sup>, 염홍기<sup>3</sup>, 김준식<sup>3</sup>, 정천기<sup>3</sup>, 김인영<sup>2</sup>, 김선일<sup>2</sup>

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<sup>2</sup>한양대학교 의공학교실

<sup>3</sup>서울대학교병원 MEG센터

The ratio of Event-related desynchronization (ERD) and event-related synchronization (ERS) is one of important features of the brain activity during motor task. To analyze ECoG signals obtained from the epilepsy patients, we used a visualization method giving time-frequency maps and statistically significant changes of the ERD/ERS during the

motor tasks. As a result, we could observe the ERD around the motor task and the ERS following the desynchronization.

### P3-43 BMI 구현을 위한 ASSR과 P300을 이용한 의도파악

최호석<sup>1</sup>, 김태경<sup>1</sup>, 송수화<sup>2</sup>, 김진률<sup>2</sup>, 송인호<sup>2</sup>, 김선일<sup>2</sup>, 김인영<sup>2</sup>

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Brain-Machine interface (BMI) is a cutting-edge technology. BMI technologies based on selective attention have employed visual or auditory stimulus to get evoked response. Recently, auditory stimulus is considered as a useful means to communicate severe spinal cord injury (SCI) or amyotrophic lateral sclerosis (ALS) patients in BMI technology. In this study, we proposed new paradigm to get increased accuracy using analyzing both auditory steady-state response (ASSR) and P300. Our results showed the possibility that can acquire better accuracy rate in BMI.

### P3-44 완전이식형 인공와우를 위한 정전 용량성 퇴먹임 증폭 회로 설계

박정환<sup>1</sup>, 김진호<sup>1</sup>, 강민규<sup>2</sup>, 송윤규<sup>2</sup>, 김성준<sup>1</sup>

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<sup>2</sup>서울대학교 융합과학기술대학원 나노융합학과

Recently, biomimetic cochlear implants have been suggested using some piezoelectric materials to generate electrical charges from acoustic waves. These piezoelectric sensors can realize totally implantable cochlear device based on MEMS fabrications and reduce remarkably power consumption to replace the conventional frequency analyzer. However, the output voltage of the piezoelectric acoustic sensor is too small (below 1 mV) to stimulate directly. To compensate the output voltage, in this study, an AC-coupled amplifier array employing pseudo-resistors was proposed and their characteristics were analyzed.

## Orthopedic and Rehabilitation Engineering

### P3-45 공압 보행 보조기를 이용한 보행 재활 훈련 시스템에 관한 연구

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In this paper, authors evaluate the effectiveness of the KAFO (Knee-Ankel-Foot Orthosis) powered by two artificial pneumatic muscles during walking on treadmill. We designed the treadmill of two-belt type for fall prevention training and used to develop the gait rehabilitation training system. To confirm the effect of developed system, muscular activities in lower limbs and foot pressure of the subject were measured in gait motion on treadmill. Subject experiments were performed in three young adults (height  $1.75 \pm 5.2\text{cm}$ , weight  $71.6 \pm 6.5\text{kg}$ , age  $24.2 \pm 0.89$  years).

### P3-46 전자기형 정원창 구동 트랜스듀서의 진동변위 향상을 위한 멤브레인의 설계

이장우<sup>1</sup>, 김동욱<sup>1</sup>, 임형규<sup>1</sup>, 조진호<sup>2</sup>

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Until now, many kinds of hearing aids have been developed to overcome hardness of hearing. One of them, fully implantable middle ear hearing device involves electro-magnetic type transducer to drive to round window. The transducer consists of magnets, coils, and closed membrane to prevent from inner body liquid. However, driving power of the transducer is limited because of tension of the membrane. In this paper, design method of electromagnetic type transducer's membrane to drive round window to increase vibration displacement has been proposed. The transducer's vibration displacement is calculated using finite element analysis (FEA). It is verified the vibration displacement can be improved according to proposed method.

### P3-47 파킨슨성 경직에 대한 뇌심부자극과 약물투여의 영향

박상훈<sup>1</sup>, 권유리<sup>1</sup>, 김지원<sup>1</sup>, 엄광문<sup>1</sup>, 이혜미<sup>2</sup>, 장지원<sup>2</sup>, 고성범<sup>2</sup>

<sup>1</sup>건국대학교 의학공학부

<sup>2</sup>고려대학교 의과대학 신경과

This study aims to investigate the effects of DBS and

medication on the rigidity of patients with Parkinson's disease. We analyzed the viscoelastic property during passive flexion and extension phases of wrist joint. Test conditions were 4 combinations of DBS (Deep Brain Stimulation) on/off and medication on/off. ANOVA showed significant difference in viscosity of extension phase between DBS on and off conditions ( $p < 0.05$ )

### P3-48 엉덩관절 외전근 손상 환자의 정성 보행 재활을 위한 하지 근육의 상호보완작용에 관한 분석

최현호, 임도형

한국생산기술연구원 실버기술개발단

Hip abductor (HA) muscle degeneration in the lower-extremity can cause an unbalanced HA muscle force (activation) contributions, resulting in an abnormal gait. This fact means that understanding of the muscle force contributions, which is required for daily living activities on the lower extremity with/without muscle pathology, is important. However, rare information about how much HA muscle forces on the lower extremity with HA muscles weakened by muscle degeneration should be recontributed and compensated during a walking for recovery from an abnormal walking is available. The current study is therefore to identify a reciprocal HA muscle force contribution required for recovery from an abnormal walking in patients with HA muscles weakened by muscle degeneration.

### P3-49 유압 타입의 가정용 골반 운동기의 어덕터 (Adductor)운동이 하지 내전근력에 미치는 영향

장영식, 권용찬, 태기식

건양대학교 의공학과

40% of old age suffer from urinary incontinence and then may have mental disabilities. We research into developing 'home adductor machine' to prevent this disease. In this study, we measured EMG in the adductor muscles and body composition in lower limbs of healthy adults (excise,  $n=5$ , control,  $n=5$ ). As a result, EMG data of excise group was significant high ( $p < 0.05$ ) after 2 weeks compared to control group. Therefore, it concluded that group which implemented home adductor excise using this device, had positive effects on adductor.



P3-50 **이동 평균 방법을 이용한 트레머 분석을 위한  
변위 추정 방법**

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We propose an estimation method of displacement for tremor analysis from acceleration. Accelerometry is available, reliable and inexpensive transducer. Therefore, many studies have used accelerometer to detect and quantify tremor. However, acceleration is not actual amplitude of tremor but, change of velocity. We measured acceleration signal to estimate displacement and double-integrated its values. Prior to 1st and 2nd integration, we used moving average to remove bias. After this, velocity was calculated by 1st integration and displacement value was reckoned by 2nd integration.

**Respiratory Engineering**

P3-51 **CPR 호흡 모니터링 시스템 개발**

이인광, 장종찬, 차은중, 김경아

충북대학교 의과대학 의공학교실, 충북대학교 차세대 선도  
의과학전문인력양성사업단

We developed a system for continuous monitoring respirational signal while CPR, using respirational airflow sensor for CPR. Signal extraction circuit obtains pressure signal while CPR. Obtained signal would be performed analog-digital conversion and changed to airflow value by characteristic formula. Single inspiration and expiration were considered a period. Detected valid data were displayed LCD.

P3-52 **스마트폰을 이용한 코골이 분석에서의 지표 분석**

정기성<sup>1</sup>, 이정수<sup>1</sup>, 황수환<sup>1</sup>, 이소진<sup>2</sup>, 정도연<sup>2</sup>, 박광석<sup>3</sup>

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<sup>2</sup>서울대학교병원 수면의학센터

<sup>3</sup>서울대학교 의과대학 의공학교실

Detecting snoring noninvasively is meaningful research, because snoring is highly related with sleep quality and obstructive sleep apnea. However, to detect snoring exactly, subjects should attach vibration sensor at their throat in hospital. We proposed snoring detection method only using microphone embedded in smart-phone. To enhance the noise canceling in detecting snoring, we adopted several parameters and validated best parameters showing best performance. Consequently speaking, when we adopted only amplitude and duration of waveform of snoring, the performance was best in detecting snoring.

P3-53 **환기역치에 근거한 최대산소섭취량 추정**

김태균, 최우혁, 신태민

연세대학교 보건과학대학 의공학과

In this study, a novel approach to predict VO2max based on Ventilatory-threshold is proposed. 108 healthy, nontrained subjects, aged 19-58 years, participated in this study. All subjects completed a submaximal treadmill GXT according to modified balke protocol. Multiple regression equation is used to predict VO2max. In results of paired t-test, there is no significant difference in both males and females between measured and detected VT. New model of predicting VO2max based on VT with was developed. From this study, it can conclude that VT was useful factor for healthy adults in predicting VO2max.

## Systems Biology, Physiological modeling

### P3-54 출혈성 쇼크를 일으킨 흰쥐에서 생리 변수, 관류 및 젖산 농도를 이용한 생존 예측

최재림<sup>1,2</sup>, 남기창<sup>2,3</sup>, 장경환<sup>1,2</sup>, 김덕원<sup>1,2</sup>

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<sup>3</sup>세브란스병원 의료기기임상시험센터

Hemorrhagic shock is the common cause of death in the emergency departments. However, there are no reliable and convenient methods available for early diagnosis and evaluation of treatment effects during hemorrhagic shock. In this study, we constructed a support vector machine (SVM) model to predict survival rate from a hemorrhagic rat model. We used physiological variables such as heart rate, systolic & diastolic blood pressure, respiration rate, and temperature. In addition to those variables, we used lactate concentration and perfusion for more accurate survival prediction model.

### P3-55 인크레틴 효과를 고려한 혈당조절 모델의 생체모델변수 추정

최가람<sup>1</sup>, 이정찬<sup>2</sup>, 김명선<sup>1</sup>, 조영민<sup>2,3</sup>, 오태정<sup>3</sup>, 김민영<sup>3</sup>, 김성완<sup>2,3</sup>, 김희찬<sup>2,3</sup>

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<sup>3</sup>서울대학교병원

Diabetes has steadily increased in Korea and glucose control is an important part of diabetes research. Incretin plays an important role in regulating glucose control and is considered for the treatment of Type 2 diabetes. In this study, pattern search technique using Nelder-Mead method for parameter estimation is used in developing glucose regulation model with incretin effect considering pathophysiological characteristics especially for Korean. Five parameters of each subject which are related to glucose control are estimated. Simulation results of virtual OGTT and IIGI based on the model are similar to the results of real OGTT and IIGI. The parameter estimation method could be further utilized in developing the tailored closed-loop control algorithm based on the patient specific diabetic characteristics.

### P3-56 Spring-hinge 모델을 이용한 폐포의 동역학적 분석

박영민, 최호석, 김태경, 김도현, 조재성, 박관수, 안종훈, 김인영

한양대학교 의용생체공학과

The approach of alveolar modeling can be divided to three parts. First one is to determine the morphological property of the alveolus, second one is to determine physical properties and roles of alveolar substances, and last one is to analyze the dynamical properties of alveoli using the morphological and physical properties of alveoli. Among those approaches, we decided the spring-hinge model for analysis of the morphological changes in the alveolus, and we analyzed dynamical properties of the alveolus in this study.

### P3-57 UV over-exposure를 이용한 microneedle 제작 기술

차보환, 채수경, 정현우, 정기석, 김법민, 이상훈  
고려대학교 생체공학학과

In this study, we introduced a simple fabrication method to make a SU-8 mold for microneedle array by the behavior of diffraction and reflection of the UV irradiation due to Fresnel principle. The effect of light behavior can produce diversity structure such as cylinder, spike cone, bullet, and mound according to the diameter on the pattern and the exposure time. We demonstrate fabrication recipe for structures and SU-8 mold array for spike-shaped microneedle. Also, we could obtain the type of height gradient SU-8 microneedle array mold for multi drugs microneedle patch with different release.

### P3-58 파킨슨병 치료를 위한 프로그램형 튜브 디바이스

박민<sup>1</sup>, 이승호<sup>1</sup>, 박천권<sup>1</sup>, 최영빈<sup>1,2,3</sup>

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Dopamine deficiency, which cause by loss of dopaminergic neurons in the substantianigra, is the major reason of the Parkinson's disease. Because a big problem in the treatment of many neurological disorders including Parkinson's disease is the inability to delivery drugs directly into the brain in the presence of a blood brain barrier, we developed the implantable tubular devices. The devices were simply fabricated by assembling individual tubes filled with Dopamine (DA) or polyethylene oxide (PEO), which act as either a drug reservoir or a diffusion barrier, respectively. Above all, the onset time of drug release and the period of the drug delivery can be controlled and programmed by the length of a PEO-filled tube. Therefore we conclude that the programmable DA-releasing tubular devices can alleviate the symptom of Parkinson's disease, effectively.

### P3-59 이식형 마이크로폰 연구를 위한 인조피부제작 및 특성측정

우승탁<sup>1</sup>, 신동호<sup>2</sup>, 황대근<sup>2</sup>, 이정현<sup>3</sup>, 조진호<sup>2</sup>

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<sup>2</sup>경북대학교 대학원 전자·전기·컴퓨터학부

<sup>3</sup>경북대학교병원 의공학과

Microphone of fully implantable hearing devices have to be implanted under tissue at the temporal bone. The tissue affects the characteristics of the microphone such as shifting a resonance frequency and sensitivity attenuation. In this paper, various artificial tissues were manufactured by using a gelatin gel for the implantable microphone. In the experiment a transmission loss (TL) was measured by using a four microphone method. The experiments show those acoustic signals were significantly reduced at the high frequencies, which reassembles the animal tissue.

### P3-60 Parafilm®의 신경세포 배양 기판 및 세포칩으로의 응용 연구

유상진, 남윤기

KAIST 바이오 및 뇌공학과

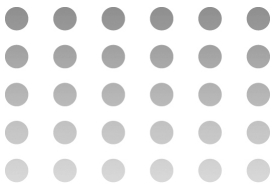
We describe the application of Parafilm® as neural cell culture substrate. The film can be easily modified by cell adhesion molecules or electrical multilayer to cultivate the neurons. E18 hippocampal neurons were cultured on the modified Para-substrate and viability, growth and development of cells were analyzed. With a micro contact printing technique, outgrowth of neurites was sharply defined against the hydrophobicity of bare surfaces. Moreover, it is easy to handle and simple to produce large quantity of culture substrates which could be used as a high throughput cell chip platform. The use of parafilm as a culture substrate shows that it could be practical and efficient substrate in neurobiological studies and cell chips.

### P3-61 피부 미용을 위한 융합 자극기 개발

오영중, 장성근, 이 전

대구한의대학교 한방의료공학과

In this paper, we introduced our dual stimulation system for skin care developed recently. This stimulation system consists of a thermo-stimulation part, a near infrared photo-stimulation part, a microcontroller based control part and a user interface part. This system can provides these two stimulations at once during preset period and the temperature of thermo-stimulation can be kept almost constantly as the selected temperature by a user almost constantly.



## P3-62 액정 고분자 박막 표면에서의 신경세포 배양

유수진, 이원희, 김성준

서울대학교 공과대학 전기컴퓨터 공학부

Recently, LCP (Liquid Crystal Polymer) is getting highlighted because it can be easily processed to fabricate flexible electrodes and/or hermetic sealing package of neural prosthetic devices—thanks to its controllable flexibility and ultra-low moisture absorption property. The purpose of this study is to test short- or mid- term biocompatibility by cultivation of neuronal cells on LCP. So we cultured neuron on LCP from 1 week to 3 weeks. In this study, we cannot find any difference between neuronal culture samples on LCP and glass control samples. As a result, it turns out that LCP material could be acceptable for neural interface material.

## P3-63 폴리이미드를 이용한 혈관 재생용 전극 디자인

김정훈<sup>1</sup>, 조태형<sup>2</sup>, 이태형<sup>1</sup>, 김인숙<sup>2</sup>, 황순정<sup>2,3</sup>, 김성준<sup>2</sup><sup>1</sup>서울대학교 공과대학 전기컴퓨터공학부<sup>2</sup>서울대학교 치과대학 치의학 연구소<sup>3</sup>서울대학교 치과대학 구강안면외과학교실

In this paper, we designed a polyimide based electrode for blood vessel regeneration. Polyimide is known as a biocompatible material and has flexible property. The electrode substrate material is polyimide and site material is gold. The designed electrode can be rolled up to adjust blood vessel structure and stimulate the entire fractured vessel area.

**U-Health, eHealth Technology**P3-64 Global u-헬스케어 서비스를 위한  
의무기록교류와 PHR 시스템 설계 및 구축안서영<sup>1</sup>, 정혜정<sup>1</sup>, 김도윤<sup>1</sup>, 전소혜<sup>1</sup>, 강승용<sup>1</sup>, 배윤형<sup>1</sup>,  
장병철<sup>2</sup>, 김남현<sup>1</sup><sup>1</sup>연세대학교 의과대학 의학공학교실<sup>2</sup>연세대학교 의과대학 흉부외과교실

Recently, as people are realizing the importance of health management and interested in it, u-healthcare service is being popular. In this study, we build the website of the concept of u-healthcare so that patients and doctors can record, check the real medical record in hospital database, PHR and also can save the data in his/her PC. Patients can have a medical service of good quality with the medical record and PHR.

P3-65 설문을 통한 전신 경혈 위치 정보 제공 가이드  
프로그램

박재현, 박선아, 윤영로

연세대학교 보건과학대학 의용전자공학과

In Oriental Medicine, acupuncture point is path way for energy of body. So, we can stimulate these points for easing pain of disease. But it is not easy to find acupuncture point. In this paper, therefore we make Guide Program to inform acupuncture point locations of whole body. This program show that picture of acupuncture point locations and stimulation way for user.

P3-66 sub-maximal 사이클 시 하지 수직정렬을  
고려한 피팅의 효과

강민성, 최진승, 강동원, 오호상, 배재혁, 탁계래

건국대학교 의료생명대학 의학공학부, 의공학 실용기술연구소

The purpose of this study was to quantitatively evaluate the effects of cycle fitting using leg vertical alignment while sub-Maximal performance. For optimizing frame size, cyclist's body sizes were fundamentally used in the all test. To compare effects of fitting, all subjects were performed sub-Maximal cycling of 40RPM before and after fitting. The results revealed that there were significant differences in decreased ROM and NJ of knee. In the most variables (pedalling power, speed, cadence and muscle activation), although not significant, they also represented positive effects. Conclusively, the results showed that it is possible

to improve cycling performance by using fitting according to leg vertical alignment.

#### P3-67 Simulink와 난청 시뮬레이터를 이용한 보청기 알고리즘 개발 및 검증

김진률<sup>1</sup>, 한종희<sup>1</sup>, 이상민<sup>2</sup>, 홍성화<sup>3</sup>, 김동욱<sup>4</sup>, 김인영<sup>1</sup>, 김선일<sup>1</sup>

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<sup>2</sup>인하대학교 전자 공학과

<sup>3</sup>성균관대학교 의과대학 이비인후과학교실

<sup>4</sup>삼성종합기술원 바이오헬스 연구실

This paper focuses on the development and evaluation of hearing aid algorithm using model based programming. Hearing aid algorithms are generally developed by hand-coding. But this method is difficult to integrate and debug. In order to improve the efficiency of integration and debugging, model based program, Mathworks Simulink, was used. Generally, the evaluation of Hearing aid algorithm evaluate by hearing loss patient, but this paper was used by Hearing Loss Simulator.

#### P3-68 웹 기반의 원격 운동량 모니터링 서버 구축

김유진, 박명환, 박주건, 박기현

계명대학교 컴퓨터공학과

In this paper, a Web-based remote activity monitoring server is proposed. The server monitors user's physical activity remotely. To achieve this, we implemented an activity information gateway and an activity monitoring server. The gateway requests the user's physical activity to a calorie tracker (or activity measurement device) and sends the information to the activity monitoring server. The activity monitoring server analyzes user's exercise patterns and shows them through the Web. This paper presents the implementation results of the activity information gateway and the activity monitoring server.

#### P3-69 가속도 센서를 이용한 보행 측정 시스템

김수찬, 배지혜<sup>1</sup>, 김성민<sup>2</sup>, 한규철<sup>1</sup>

한경대학교 바이오·정보기술 대학원

<sup>1</sup>가천의대 이비인후과학교실

<sup>2</sup>동국대학교 바이오시스템대학 의생명공학과

About half of outpatients who complain dizziness came out to be positive on nystagmus and position change examination. As such patients increase, developing a device

that monitors vestibular function in long term is urgently needed for accurate diagnose. This study focuses on developing diagnostic and monitoring device that is inexpensive and portable, and has high test sensitivity and singularity. In this study, we proposed the portable system for evaluation of walking pattern. It is consisted of four 3-axis accelerometers, a trigger button, a SD memory card, and a low-power microcontroller. To test out the device, various tasks that were designed as unexpected events throughout the day including Romberg test were tested on patients' group and normal group, and those data were used as a selection of parameters for analysis program. In the near future, development of software program that analyze patients activities in separate sensors would make this device usable and convenient on determining the patient's disease.

#### P3-70 제논 램프 방사를 위한 소형 전원 공급 시스템 설계

엄영일, 이균정, 신태민

연세대학교 의공학과

The IPL (Intense Pulsed Light) need high voltage and current to emit a Xenon lamp. Existing IPL to provide a power source uses a high voltage power supply consisted of transformers. The transformer has a feature that is large and heavy. The Voltage multiplier consisted of diodes and capacitors also generates a boosted voltage and is simple to make a composition of circuit and be relatively small and light. Hence, this research investigates the use possibility through the voltage multiplier method replaced the transformer.

#### P3-71 ECG의 R-R간격과 R-R간격 표준편차를 이용한 운동강도의 패턴 분류 연구

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The aim of this paper is the classification of exercise intensity using both R-R interval and standard deviation of R-R Interval. According to the speed profile, the subject takes exercise on the treadmill. The speed profile includes rest (0), 3, 6, and 9 Km/h. Each speed took a total period of 5 min, and was followed by a 10-min resting period. In this paper, we obtained covariance matrix after the acquisition data was modeled using the bivariate Gaussian probability density function. As a result of analysis, the R-R interval and standard deviation of R-R interval were useful in the classification to the high and low intensity exercise respectively.

P3-72 **모바일 기기에서 얻은 심전도 신호의 노이즈 제거 기술**

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Monitoring electrocardiogram (ECG) is playing an important role in ubiquitous healthcare (U-Healthcare) system, because ECG is the fundamental vital information of a patient. There have been a lot of researches conducted that dealing with noises and analyzing clinical information with in ECG. Those conventional studies mainly dealing with ECGs acquired at hospital which means the signals were acquired with under well-controlled situation. However, in the U-healthcare system, ECG signals are expected to be acquired with mobile device under any uncontrolled situation, so conventional denoising method is not proper to use. We introduce a new ECG denoising method for ECG acquired from mobile device.

P3-73 **트레드밀 운동 중 가슴에서의 체표면 온도 측정에 관한 기초 연구**

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The purpose of this study, the trunk skin temperature will be verify controlled by surface temperature change during exercise when measured by 4 point (forehead, trunk, arm and leg) skin temperature with 6km/h treadmill exercise. Six healthy male college students participated in a test which is composed of rest for 5 min., exercise for 20 min, and recovery for 10min, to measure their skin temperature with BIOPAC (SKT100C). As a result, the average skin temperature and trunk skin temperature was very high correlation, is able to confirm regulation of skin temperature variability during exercise.

P3-74 **웹 기반 국제원격진료시스템 설계 및 구현**

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Medical consumers want to have a medical service actively and industry is trying to attract foreign patients. However, awareness of Korea medical quality is underestimated among foreign patient. The purpose of this study was to design and implement international telemedicine system using website and it was composed of five components of languages for foreigner. This system has reservation system, consultation system and consultation history system. We hope to use this system over international healthcare system.