10th International Biomedical Engineering Conference

IBEC 2024

7.Thu~9.Sat Nov 2024

Swiss Grand Hotel, Seoul

"From Lab to Life: Bringing Biomedical Innovations to Industry"

대한의용생체공학회
The Korean Society of Medical & Biological Engineering

고려대학교 BK21 정밀보건과학교육연구단
BK21FOUR R&E Center for Precision Public Health

인하대학교 BK21 정밀의학·스마트공학 융합 교육연구단
Precision Medicine& Smart Engineering

연세대학교 BK21 맞춤형 NBIT 융복합 의료기기 교육연구단
BK21Four Education and Research Center of NBIT- Integrated Medical System for Personalized Healthcare

SHELFAS TEAM
Smart HEalthcare Leaders For Active Seniors
강원대학교 BK21 Four 맞춤형 스마트 헬스케어 사업단

FOUR BK21

SNU AI.MED
서울대학교 의료 인공지능 융합인재 양성 사업단

Korea Disease Control and Prevention Agency
National Institute of Health

Seoul National University Global Data-X Leader HRD
Project Group for Education and Research in Medical AI
Education and Research Program for Future ICT Pioneers

Table Of Contents

10th International Biomedical Engineering Conference

Welcome Letter

Conference chair

Dear IBEC colleagues and friends,

It is with great enthusiasm and anticipation that we extend a warm welcome to IBEC 2024. This year marks the 10th International Biomedical Engineering Conference, proudly hosted by the Korean Society of Medical & Biological Engineering (KOSOMBE). From November 7th to 9th, 2024, we are honored to convene the brightest minds of our IBEC community in the heart of Seoul, Korea.

The theme for this year's conference, "From Lab to Life: Bringing Biomedical Innovations to Industry" reflects the critical moment we are living in. Biomedical engineering is no longer confined to research labs; it is now driving global healthcare transformation. In a world facing unprecedented challenges, from emerging diseases to aging populations, the importance of rapidly translating cutting-edge research into real-world, scalable applications has never been more critical. IBEC 2024 will spotlight the trailblazing role of biomedical engineering in reshaping healthcare delivery, accelerating innovation, and enhancing quality of life worldwide.

This year's meticulously curated scientific program will showcase groundbreaking advancements in biomedical engineering, with sessions exploring the latest innovations across diverse themes: Brain Engineering, Biomedical Instrumentation, Medical Image, Processing and Systems, Medical Artificial Intelligence, Biosensors & Biochips, Biomedical Optics, Biomaterials, Biomechanics & Medical Robotics, Clinical Medical Devices, Medical Device Regulatory Science.

In addition to these thought-provoking sessions, IBEC 2024 will feature an innovative exhibition where leading biomedical companies, start-ups, research institutions, and universities will present cutting-edge technologies and solutions. This platform will provide invaluable opportunities for professionals including engineers, clinicians, scientists, entrepreneurs, and students to collaborate and exchange insights, fostering the cross-disciplinary innovation that is essential for the future of healthcare.

Taking place in the dynamic metropolis of Seoul, one of Asia's most iconic cities renowned for its technological prowess and vibrant culture, the conference will be held at the Swiss Grand Hotel. In line with global sustainability efforts, IBEC 2024 is committed to ensuring that our conference reflects not only our commitment to advancing science and technology but also our shared responsibility to safeguard the planet.

As we look ahead to November 2024, we eagerly anticipate your participation in what promises to be an inspiring and transformative event. Together, we will explore the next frontier of biomedical engineering, drive the innovations that will define the future of healthcare, and turn visionary research into life-changing solutions. We are confident that IBEC 2024 will leave a lasting impact on all who attend, and we look forward to welcoming you to Seoul for an unforgettable journey into the future of biomedical innovation.

Sincerely,

Jae-Seon Lee

Conference Chair

IBEC 2024

Conference official

Chair: **Jae-Seon Lee** (Inha University)

Co-Chairs:
Jongmo Seo (Seoul National University)
Sang Woo Lee (Yonsei University Mirae Campus)
Byeong Hee Kim (Kangwon National University)
Soon-Sun Hong (Inha University)
Honggu Chun (Korea University)

Local Committee:
Jong-Ho Cha (Inha University)
Dasol Lee (Yonsei University Mirae Campus)
Kwang Suk Lim (Kangwon National University)
Kyu Back Lee (Korea University)
Sang-Min Lee (Inha University)
Sung-min Park (Pohang University of Science and Technology)
Daeyu Kim (Inha University)
Jahyun Koo (Korea University)
Jaehong Key (Yonsei University Mirae Campus)
Hangsik Shin (University of Ulsan College of Medicine)
Dowon Kim (Chonnam National University)
Kwang Gi Kim (Gachon University)

Poster Award Chairs:
Jong-Ho Cha (Inha University)
Dasol Lee (Yonsei University Mirae Campus)
Kwang Suk Lim (Kangwon National University)
Daeyu Kim (Inha University)
Jahyun Koo (Korea University)

KOSOMBE officers and directors

Former President	Myoung Nam Kim	Kyungpook National University
President	Kyu Back Lee	Korea University
President-Elect	Sangmin Lee	Inha University
Vice President	Wonsik Ahn	Kyunghee University
	Jae-Hwa Lee	Korea Medical Device Industry Cooperative Association
Auditor	Chi-Woong Mun	Inje University
	Sung Min Kim	Dongkuk University
Director of General Affairs	Hangsik Shin	Asan Medical Center
Director of Finance	Jyung Hyun Lee	Kyungpook National University
Director of Future and Vision Planning	Sunguk Kuh	Yonsei University
	Jongmo Seo	Seoul University
Chair of Academic Program Committee	Sung-Min Park	POSTECH
	Jahyun Koo	Korea University
	Jaehong Key	Yonsei University
	Daeyu Kim	Inha University
Editor-in-Chief (Journal of Biomedical Engineering Research)	Ki-Sik Tae	Kunyang University
Editor-in-Chief (Biomedical Engineering Letters)	Jae Sung Lee	Seoul University
Chair of Education Program Committee	Jennifer Hyunjong Shin	KAIST
	Do-Won, Kim	Jeonnam University
	Young Don Son	Gachon University
	Sung Young Choi	Hanyang University
	Jin Ho Chang	DGIST
	Daesung Yoon	Korea University
	Hyung-Sik Kim	Konkuk University
	Jung Woog Shin	Inje University
	Won Seuk Jang	Yonsei University
	Ki Joo Pahk	Kyunghee University

Director of Information & Communications	Seong-Wook Choi	Kangwon National University
	Sejung Yang	Yonsei University
Director of Public Relations	Yun Kyung Jung	Inje University
	Seojung Ha	Sangji University
Director of Industry-Academic Cooperation	Kwang Gi Kim	Gachon University
	Ki Chang Nam	Dongkuk University
	Jong-Ha Lee	Keimyung University
	Junghwan Oh	Pukyong national University
	Byungjo Jung	Yonsei University
	SooWon Seo	KMEDIhub
	Yong Hun Lim	KBIOHealth
	Myeongbae Yang	Wonju Medical Device Techno Valley Foundation
	Byung-Yeol Cha	GBIA
Director of International Cooperation	Chulhong Kim	POSTECH
	Young Bin Choy	Seoul University
Special Director of Convergence	Yung-Ho Jo	National Cancer Center
	Taegeon Kang	Korea University
	Rena Lee	Ewha women's University
	Beop-Min Kim	Korea University
	Chang-Hwan Im	Hanyang University
	Uicheul Yoon	Daegu Catholic University
	Jae Youn Hwang	DGIST
	Kyung Min Byun	Kyunghee University
	Hyoun-Joong Kong	Seoul University
	Jaesoon Choi	Asan Medical Center

Exhibitors

리골코리아	재단법인 오송첨단의료산업진흥재단
연세대학교	산업부 병원-기업협력사업
(주)두리시스템테크놀로지	주식회사 지브레인
동국대학교 의료기기산업학과	김해의생명산업진흥원
계명대학교 사용성평가연구센터	(주)제윤
주식회사 뉴퐁	스피나시스템즈(주)
주식회사 레오헬스케어	엘티바이오(주)
주식회사 인벨류비즈	(주)위무브
BMEL	대구경북첨단의료산업진흥재단
(주)엠큐브테크놀로지	엣지케어
(주)싸이웰에스엔비	재활공학연구소
연세대학교 미래캠퍼스 의료AI반도체전문인력양성사업단	한국과학기술젠더혁신센터
주식회사 밀 알	(주)현대메디텍
(재)원주의료기기테크노밸리	시지바이오
한국의료기기안전정보원	주식회사 오토웰즈
한국의료기기협동조합	식품의약품안전처
우영메디칼	사단법인 한국의료기기산업협회
대한병원협회	대성마리프

TIME TABLE

	11.7 (Thursday)	
	Main Building 2F White	Main Building 2F Peacock
9:00		
10:00		
11:00		
12:00		
13:00	IBEC5 Seoul National University BK21 Future ICT Pioneer /Medical AI/Global Data-X HRD (13:15~15:15)	IBEC1 Yonsei University Mirae Campus BK21 Education and Research Center of NBIT-integrated Medical System for Personalized Healthcare (13:15~15:15)
14:00		
15:00		
16:00		IBEC2 Kangwon National University BK21 Smart Healthcare Technology (15:45~17:45)
17:00		
18:30		

	11.8 (Friday)		
	Convention 3F Emerald-A	Convention 3F Emerald-B	Main Building 2F Peacock
9:00			IBEC3 Korea University BK21 Four Institute of Precision Public Health (9:00~11:00)
10:00			
11:00	Opening Ceremony / General Assembly (11:00~11:45)		
12:00			
13:00	Lunch Break (12:45~13:45)		
14:00			
15:00	Coffee Break (15:45~16:00)		
16:00			IBEC4 Inha University BK21 Precision Medicine & Smart Engineering (16:15~18:00)
17:00			
18:30	Dinner in Main building 2F Grand Ballroom		

	11.9 (Saturday)	
	Convention 3F Emerald-A	Convention 3F Emerald-B
9:00		
10:00		
11:00		
12:00	Closing ceremony (11:45~12:15)	
13:00		
14:00		
15:00		
16:00		
17:00		
18:30		

CONTENTS

IBEC3. Korea University

BK21 FOUR Institute of Precision Public Health
November 8, 09:00 ~ 11:00, Main Building 2F Peacock

Chair: Prof. Honggu Chun (Korea University)

Magnetic implants for wireless biosensing — Mengdi Han (Dept of Biomedical Engineering, Peking University)

Non-invasive, real-time tracking of cell-based therapies — Jinhwan Kim (Dept of Biomedical Engineering, UC Davis)

AI in revolutionizing mental health — Ngo Thi Lua (Dept of Biomedical Engineering, Vietnam National University)

Nanostraw Electro-actuated Transfection (NExT) for non-viral, high-throughput genetic engineering of diverse primary immune cells — Andy Tay Kah Ping (National University of Singapore)

RNA-Seq Based Verification of Organoid Generation Reproducibility for Precision Medicine — Okju Kim (ATG Lifetech)

IBEC4 . Inha University

BK21 FOUR Precision Medicine & Smart Engineering
November 8, 16:15 ~ 18:15, Main Building 2F Peacock

Chair: Bongseob Shim (Inha University), Soo Geun Yang (Inha University)

A Portfolio of Engineered Fc Variants for Enhancing Potency, Silencing Effector Functions, or Extending the Half-Life of Therapeutic Antibodies
Sang Taek Jung (School of Chemical and Biological Engineering, College of Engineering, Seoul National University)

Antibody Engineering of therapeutic antibodies: Understanding the elements involved in recombinant production, superantigen/antigen-binding and IgE-mediated allergy responses
Gan Ken En Samuel (College of Science and Technology, Wenzhou-Kean University)

Light-responsive nanoparticles for drug delivery — Peerapat Thongnuek (Chulalongkorn University)

Investigating the Impact of Polymer Branching on Nano-Bio Interactions
Kwangsoo Shin (Department of Polymer Science & Engineering, Inha University)

Generation and Control of Bioplasma-based Bioactive Species for the Development of Next-Generation Cancer Immunotherapy — Yun Suk Huh (Department of Biological Engineering, Inha University)

IBEC5. Seoul National University

BK21 FOUR Future ICT Pioneers, GoGE/SDG
Project Group for Education and Research in Medical AI / Global Data-X Leader HRD
November 7, 13:15 ~ 15:15, Main Building 2F White

Chair: Jongmo Seo (Seoul National University), Kyu Eun Lee (Seoul National University)

Deep learning powered advanced susceptibility imaging at 7T — Jiye Kim (Seoul National University)

Review of a patient-pndependent approach to epilepsy detection with 0-shot training via seizure-cluster-inception CNN (Sci-CNN) — Hyoungjoon Kim (Seoul National University)

The impact of healthcare workers' movements on the spread of air-borne infection factors — Jong Hyeon Lee (Seoul National University)

AI healthcare in China — Zihuan Wang (China Eye Valley, Wenzhou, China)

Protein structure models in the AI era: where do experiments and dynamics fit in? — Zoltán Gáspári (Pázmány Péter Katolikus Egyetem, Budapest, Hungary)

Spatial sensor-based augmented reality — György Cserey (Pázmány Péter Katolikus Egyetem, Budapest, Hungary)

Recent advancement of flexible MEMS-based neural interface — Jisung Kim (Seoul National University Hospital)

PROGRAM

November 7 (Thursday)

Location					
Time	Main Building 2F Peacock IBEC1: Yonsei University Mirae Campus		Main Building 2F White IBEC5: Seoul National University		Main Building 2F Peacock IBEC2: Kangwon National University
13:15 ~ 13:35	**Bryan Yoon** (Department of Child, Adolescent Psychiatry, New York University School of Medicine) Neuroimaging in Psychiatric Disorders: Historical Insights and Future Directions	13:15 ~ 13:25	**Jiye Kim** (Seoul National University) Deep learning powered advanced susceptibility imaging at 7T	15:45 ~ 16:15	**Jaewon Lee** (Departmaent of Mechanical and Aerospace Engineering, University of Missouri) Understanding self-assembly through Population Balance Theory
13:35 ~ 14:55	**Dongjun Jung** (Massachusetts Institute of Technology. MIT) Soft metallic bioelectronics for medical applications	13:25 ~ 13:35	**Hyoungjoon Kim** (Seoul National University) Review of a patientindependent approach to epilepsy detection with 0-shot training via seizure-cluster-inception CNN (Sci-CNN)	16:15 ~ 16:45	**Jae Hoon Sim** (Department of Otorhinolayngology, University Hospital Zurich) Prediction of surgical outcomes of middleear implants at development stages
13:55 ~ 14:20	**Myeongsu Seong** (Xi'an Jiaotong-Liverpool University) Classification of Alzheimer's and age-matched animal using hemodynamic signals during hypoxic gas challenge	13:35 ~ 13:45	**Jong Hyeon Lee** (Seoul National University) The impact of healthcare workers' movements on the spread of air-borne infection factors	16:45 ~ 17:15	**Il Doh** (KRISS, Medical Metrology Group) Measurement Standards for Medical Devices in KRISS

November 7 (Thursday)

Location					
Time	Main Building 2F.Peacock IBEC1. Yonsei University Mirae Campus		Main Building 2F White IBEC5: Seoul National University		Main Building 2F Peacock IBEC2: Kangwon National University
14:20 ~ 14:45	**Inki Kim** (Department of Biophysics, Sungkyunkwan University) Metasurfaces for biosensing, molecular diagnostics, biomedical imaging	13:45 ~ 14:05	**Zihuan Wang** (China Eye Valley, Wenzhou, China) AI healthcare in China	17:15 ~ 17:45	**ByeongHee Kim** (Kangwon National University, Smart Health Science and Technology Convergence) Real-time drowsy driving detection system through driver fatigue prediction based on face tracking
14:45 ~ 15:10	**Jinsik Kim** (Department of Biomedical Engineering, Dongguk University) Semiconducting Nanomaterials Based Devices for Understanding Neurodegenerative Diseases	14:05 ~ 14:35	**Zoltán Gáspári** (Pázmány Péter Katolikus Egyetem) Protein structure models in the AI era: where do experiments and dynamics fit in?		
		14:35 ~ 15:55	**György Cserey** (Pázmány Péter Katolikus Egyetem) Spatial sensor-based augmented reality		
		14:55 ~ 15:15	**Jisung Kim** (Seoul National University Hospital) Recent advancement of flexible MEMS-based neural interface		

November 8 (Friday)

Location			
Time	Main Building 2F Peacock IBEC3: Korea University	Time	Main Building 2F Peacock IBEC4: Inha University
09:00 ~ 09:20	**Mengdi Han** (Peking University (Dept of Biomedical Engineering) Magnetic implants for wireless biosensing	16:15 ~ 16:40	**Sang Taek Jung** (School of Chemical and Biological Engineering, College of Engineering, Seoul National University) A Portfolio of Engineered Fc Variants for Enhancing Potency, Silencing Effector Functions, or Extending the Half-Life of Therapeutic Antibodies
09:25 ~ 09:45	**Jinhwan Kim** (UC Davis) Non-invasive, real-time tracking of cell-based therapies	16:40 ~ 17:05	**Gan Ken En Samuel** (College of Science and Technology, Wenzhou-Kean University) Antibody Engineering of therapeutic antibodies: Understanding the elements involved in recombinant production, superantigen/antigen-binding and IgE-mediated allergy responses
09:50 ~ 10:10	**Ngo Thi Lua** (Vietnam National University) AI in revolutionizing mental health	17:05 ~ 17:30	**Peerapat Thongnuek** (Biomedical Engineering Program, Faculty of Engineering, Chulalongkorn University) Light-responsive nanoparticles for drug delivery

November 8 (Friday)

Location			
Time	Main Building 2F Peacock IBEC3: Korea University	Time	Main Building 2F Peacock IBEC4: Inha University
10:15 ~ 10:35	**Andy Tay Kah Ping** (National University of Singapore) Nanostraw Electro-actuated Transfection (NExT) for non-viral, high-throughput genetic engineering of diverse primary immune cells	17:30 ~ 17:55	**Kwangsoo Shin** (Department of Polymer Science & Engineering, Inha University) Investigating the Impact of Polymer Branching on Nano-Bio Interactions
10:40 ~ 11:00	**Okju Kim** (ATG Lifetech) RNA-Seq Based Verification of Organoid Generation Reproducibility for Precision Medicine	17:55 ~ 18:15	**Yun Suk Huh** (Department of Biological Engineering, Inha University) Generation and Control of Bioplasma-based Bioactive Species for the Development of Next-Generation Cancer Immunotherapy

Nov. 7 Thursday PROGRAM

IBEC1 | Yonsei University Mirae Campus

Chair: Prof. Hye Jin Kim (Yonsei University)

Main Building 2F Peacock (13:15 ~ 15:15)

Neuroimaging in Psychiatric Disorders: Historical Insights and Future Directions

Bryan Yoon
Department of Child and Adolescent Psychiatry, New York University School of Medicine

Soft metallic bioelectronics for medical applications

Dongjun Jung
Massachusetts Institute of Technology. MIT

Classification of Alzheimer’s and age-matched animal using hemodynamic signals during hypoxic gas challenge

Myeongsu Seong
Xi’an Jiaotong-Liverpool University

Metasurfaces for biosensing, molecular diagnostics, and biomedical imaging

Inki Kim
Department of Biophysics, Sungkyunkwan University

Semiconducting Nanomaterials Based Devices for Understanding Neurodegenerative Diseases

Jinsik Kim
Department of Biomedical Engineering, Dongguk University

Nov. 7 Thursday PROGRAM

IBEC5 | Seoul National University

Chair: Jongmo Seo (College of Engineering, Seoul National University)
Kyu Eun Lee (College of Medicine, Seoul National University)

Main Building 2F Wihte (13:15 ~ 15:15)

Deep learning powered advanced susceptibility imaging at 7T
Jiye Kim
Seoul National University

Review of a patient-independent approach to epilepsy detection with 0-shot training via seizurecluster-Inception CNN (Sci-CNN)
Hyoungjoon Kim
Seoul National University

The impact of healthcare workers' movements on the spread of air-borne infection factors
Jong Hyeon Lee
Seoul National University

AI Healthcare in China
Zihuan Wang
China Eye Valley (Wenzhou, China)

Protein structure models in the AI era: where do experiments and dynamics fit in?
Zoltán Gáspári
Pázmány Péter Katolikus Egyetem, Budapest, Hungary

Spatial sensor-based augmented reality
György Cserey
Pázmány Péter Katolikus Egyetem, Budapest, Hungary

Recent advancement of flexible MEMS-based neural interface
Jisung Kim
Seoul National University Hospital

Nov. 7 Thursday PROGRAM

IBEC2 | Kangwon National University

Chair: Prof. ByungHee Kim (Kangwon National University)

Main Building 2F Peacock (15:45 ~ 17:45)

Understanding self-assembly through Population Balance Theory
Jaewon Lee
Mechanical and Aerospace Engineering, University of Missouri

Prediction of surgical outcomes of middle-ear implants at development stages
Jae Hoon Sim
Department of Otorhinolayngology, University Hospital Zurich

Measurement Standards for Medical Devices in KRISS
Il Doh
KRISS, Medical Metrology Group

Real-time drowsy driving detection system through driver fatigue prediction based on face tracking
ByeongHee Kim
Kangwon National University, Smart Health Science and Technology Convergence

Nov. 8 Friday PROGRAM

IBEC3 | Korea University

Chair: Prof. Honggu Chun (Korea University)

Main Building 2F Peacock (09:00 ~ 11:00)

Magnetic implants for wireless biosensing
Mengdi Han
Peking University (Dept of Biomedical Engineering)

Non-invasive, real-time tracking of cell-based therapies
Jinhwan Kim
UC Davis (Dept of Biomedical Engineering)

AI in revolutionizing mental health
Ngo Thi Lua
Vietnam National University (Dept of Biomedical Engineering)

Nanostraw Electro-actuated Transfection (NExT) for non-viral, high-throughput genetic engineering of diverse primary immune cells
Andy Tay Kah Ping
National University of Singapore

RNA-Seq Based Verification of Organoid Generation Reproducibility for Precision Medicine
Okju Kim
ATG Lifetech

Nov. 8 Friday PROGRAM

IBEC4 | Inha University

Chair: **Bongseob Shim** (Inha University), **Soo Geun Yang** (College of Medicine, Inha University)

Main Building 2F Peacock (16:15 ~ 18:15)

A Portfolio of Engineered Fc Variants for Enhancing Potency, Silencing Effector Functions, or Extending the Half-Life of Therapeutic Antibodies

Sang Taek Jung
School of Chemical and Biological Engineering, College of Engineering, Seoul National University

---

Antibody Engineering of therapeutic antibodies: Understanding the elements involved in recombinant production, superantigen/antigen-binding and IgE-mediated allergy responses

Gan Ken En Samuel
College of Science and Technology, Wenzhou-Kean University

Light-responsive nanoparticles for drug delivery

Peerapat Thongnuek
Biomedical Engineering Program, Faculty of Engineering, Chulalongkorn University

---

Investigating the Impact of Polymer Branching on Nano-Bio Interactions

Kwangsoo Shin
Department of Polymer Science & Engineering, Inha University

Generation and Control of Bioplasma-based Bioactive Species for the Development of Next-Generation Cancer Immunotherapy

Yun Suk Huh
Department of Biological Engineering, Inha University

POSTER PROGRAM

Poster session of the IBEC 2024 is hosted by
Yonsei University Mirae Campus BK21 Education and Research Center of NBIT-integrated Medical System for Personalized Healthcare
Kangwon National University BK21 Smart Healthcare Technology
Korea University BK21 Institute of Precision Public Health
Inha University BK21 Precision Medicine & Smart Engineering
Seoul National University BK21 Future ICT Pioneers, GoGE/SDG
Seoul National University Project Group for Education & Research in Medical AI / Global Data-X Leader HRD

IP-001

Mitigate effects of cytotoxicity and inhibition of NF-κB expression following PEMF stimulation in inflammatory response of HaCaT cells induced by TNF-α/IFN-γ

Jun-Young Kim[1], Chan-Ho Park[1], and Yong-Heum Lee[1]
[1]Biomedical Electromagnetic System Laboratory, Department of Biomedical Engineering, Yonsei University, Wonju 26493, Korea

IP-002

Development of Silk Protein Composite-Based Paclitaxel-Loaded Nanoparticles and Evaluation of Anticancer Effects on Cervical Cancer Cells

Yoonho Hwang[1], Hyeyoun Cho[1], Jaehoon Ko[1], Rumana Ferdushi[1], Jaehong Key[1]
[1]Department of Biomedical Engineering, Yonsei University, Wonju, Korea

IP-003

Development of silk protein-based drug delivery system for lung cancer treatmen

Hyeyoun Cho[1], Rumana Ferdushi[1], Yoonho Hwang[1], Jaehoon Ko1 and Jaehong Key[1]
[1]Department of Biomedical Engineering, Yonsei University, Korea

IP-004

Safeguarding Hearing from Loss with the Use of Fucoidan loaded SPIONs and Dexamethasone Nanoparticles Delivered through Magnetic Attraction Rumana

Ferdushi[1], Hyeyoun Cho[1], Yoonho Hwang[1], Jaehoon K[1], Jaehong Key[1]
[1]Department of Biomedical Engineering, Yonsei University, Korea l

IP-005

PVA/SiO_2/CA electrospun nanofiber with radiative cooling

Seokgyu Kwon[1], Changhwan Hyeon[1], Minseo Jeong[1], Dasol Lee[1]
[1]Department of Biomedical Engineering, Yonsei University, Wonju, Korea

IP-006

Tau oligomer–degrading drug discovery platform using tau amyloid corona–shelled nanoparticles

Junho Bang[1,2], Hyo Gi Jung[1,2], Dae Sung Yoon[1,2*]
[1]School of Biomedical Engineering, Korea University, Seoul 02841, Republic of Korea
[2]Interdisciplinary Program in Precision Public Health, Korea University, Seoul 02841, Republic of Korea

IP-007

Wet spinning of cellulose nanofibrils toward biomedical applications

Gyuhui Park[1] and Bong Sup Shim[1,2]
[1]Program in Biomedical Science & Engineering, Inha University
[2]Department of Chemical Engineering, Inha University

IP-008

Fabrication process of 3D plateau structure implatable PFA–based electrodes for effective stimulation

Jiseon Lee[1], Jisung Kim[2], Buri Kim[2] and Jongmo Seo[1,3*]
[1]Department of Electrical and Computer Engineering, Seoul National University
[2]Department of Transdisciplinary Medicine, Seoul National University Hospital
[3]Biomedical Research Institute, Seoul National University Hospital, Korea

IP-009

Optimized site opening in COC–based neural electrodes for retinal implants using reactive ion etching (RIE)

Taekyung Lee[1], Joowon Lee[1], Jong–Mo Seo[1,2*]
[1]Department of Electrical and Computer Engineering, Seoul National University, Korea
[2]Biomedical Research Institute, Seoul National University Hospital, Korea

IP-010

Impact of Oxygen Plasma Treatment on Surface Properties and Metal Adhesion of Cyclic Olefin Copolymer (COC)

Joowon Lee[1], Taekyung Lee[1], Jong hyeon Lee[2], and Jong–mo Seo[1,3*]
[1]Electrical and Computer Engineering, Seoul National University, Korea
[2]Department of Transdisciplinary Medicine, Seoul National University Hospital, Korea
[3]Biomedical Research Institute, Seoul National University Hospital, Korea

IP-011

Fabrication of functionally graded multi–ceramic structure using digital light processing (DLP) 3D printing technique with passive in line mixing concept

Gyu–Nam Kim[1,2], Jae–Min Jung[1,2], Jae–Hyung Park[1,2], Jun–Sik Kim[1,2], Jae–Uk Song[1,2], Nelly Aimelyne Mpuhwe[1,2], Young–Hag Koh[1,2*]
[1]School of Biomedical Engineering, Korea University, Seoul, Korea
[2]Interdisciplinary Program in Precision Public Health, Korea University, Seoul, Korea.

IP-012

Manufacturing and Characterization of Dental Crowns Made of 5-mol% Yttria Stabilized Zirconia by Digital Light Processing

Jae-Min Jung[1,2], Gyu-Nam Kim[1,2], G, Jae-Hyung Park[1,2], Jae-Uk Song[1,2], Jun-Sik Song[1,2], Nelly Aimelyne Mpuhwe[1,2] and Young-Hag Koh[1,2]
[1]Department of Biomedical Engineering, Korea University, Seoul, Korea
[2]Interdisciplinary Program in Precision Public Health, Korea University, Seoul, Korea.

IP-013

Bio-inspired calcium phosphate scaffolds with dual-scale porosity honeycomb cores surrounded by dense shells using phase separation assisted DLP

Jae-Uk Song[1,2], Gyu-Nam Kim[1,2], Jae-Min Jung[1,2], Jae-Hyung Park[1,2], Nelly Aimelyne Mpuhwe[1,2], Jun-Sik Kim[1,2], Young-Hag Koh[1,2*]
[1]School of Biomedical Engineering, Korea University
[2]Interdisciplinary Program in Precision Public Health, Korea University

IP-014

Development of Antibacterial Resin Composite for DLP 3D Printing Applications Using CeO_2 Nanoparticles

Jun-Sik Kim[1,2], Gyu-Nam Kim[1,2], Jae-Min Jung[1,2] Jae-Hyung Park[1,2]. Jae-Uk Song[1,2], Nelly Aimelyne Mpuhwe[1,2], Young-Hag Koh[1,2*]
[1]Department of Biomedical Engineering, Korea University, Seoul, Korea
[2]Interdisciplinary Program in Precision Public Health, Korea University, Seoul, Korea.

IP-015

Enhancing radiotherapy efficacy for pancreatic cancer treatment through gold nanoparticle-based drug delivery system

Seonmin Choi[1,2], Yoonho Hwang[1], Hyeyoun Cho[1] and Jaehong Key[1*]
[1]Department of Biomedical Engineering, Yonsei University, Korea
[2]R&D centre, RayMed., Co., Ltd, Oseong 10408, Korea

IP-016

Production of recombinant PETase by Escherichia coli and Optimization of PET biodegradation conditions

Jang-Sub Lee[1], Yeon-Jin Hong[1], Jin-Seob Shin[1], Hyung-Seok Lee[1], Byeong-Hee Kim[1], Suk-Jin Ha[1,*]
[1]Department of Biohealth-machinery convergence engineering, Kangwon National University, Chuncheon 24341, Republic of Korea

IP-017

Enhanced Interconnected Porous Microspheres via Photocuring-Assisted Emulsion of Ceramic Suspensions Using camphene and camphor as Dual Pore-Forming Agent

Jae-Hyung Park[1,2], Jae-Min Jung[1,2], Gyu-Nam Kim[1,2], Jae-Uk Song[1,2], Jun-Sik Kim[1,2], Nelly Aimelyne Mphuwe[1,2], Young-Hag Koh[1,2*]
[1]School of Biomedical Engineering, Korea University, Seoul, 02841, South Korea
[2]Interdisciplinary Program in Precision Public Health, Korea university

IP-018

Development of 3D printed antimicrobial CeO_2 loaded GelMa/PEGDA hydrogel with wound healing properties

Chaewon Mpuhwe Nelly Aimelyne[1,2], Gyu-Nam Kim[1,2], Jae-Uk Song[1,2], Jun-Sik Kim[1,2], Jae-Min Jung[1,2], Jae-Hyung Park[1,2], Young Hag Koh[1,2*]
[1]School of Biomedical engineering, Korea University, Seoul, Korea
[2]Interdisciplinary Program in Precision Public Health, Korea University, Seoul, Korea

IP-019

Synthesis and characterization of a chitosan-graphene composite for flexible strain sensors in biomedical health monitoring

Doljinsuren Enkhbayar[1], Ahmed Ali[1,2], Riaz Muhammad[1], Ezekiel Edward Nettey-Oppong[1], Young-Seek Seok[3], Seong-Wan Kim[4], and Seung Ho Choi[1,5]
[1]Department of Biomedical Engineering, Yonsei University, Wonju 26493, Republic of Korea
[2]Department of Electrical Engineering, Sukkur IBA University, Sukkur 65200, Pakistan
[3]Gangwon-do Agricultural Product Registered Seed Station, Chuncheon 24410
[4]Department of Agricultural Biology, National Institute of Agricultural Sciences, Rural Development Administration, Wanju, Jeollabuk-do 55365, Republic of Korea
[5]Department of Integrative Medicine, Major in Digital Healthcare, Yonsei University College of Medicine, Seoul 06229, Republic of Korea

IP-020

Wrinkled PDMS-based Microfluidics Channel applied surface modification Droplet Generation

Jingwon Kim[1], Young Woo Gwak[1], Sugeun Lee[1], Danyou Lim[2], Sang Woo Lee[1*] and Insu Park[2*]
[1]Department of Biomedical Engineering, Yonsei University, Korea
[2]Department of Biomedical Engineering, Konyang University, Korea

IP-021

Optimization of a multi-frequency SSVEP-Based BCI Based Korean Speller with CHEONJIIN-style keyboard

Jiwon Ahn[1], Min-A Jeon[1], Giyeon Yu[1], Dohyun Yoo[1], Riaz Muhammad[1], Seung Ho Choi[1*]
[1]Department of Biomedical Engineering, Yonsei University, Wonju, Korea

IP-022

Development of an auditory brainstem response measurement system for hearing impairment assessment based on deep learning

Sanghoon Nam[1], Yeoeun Choi[1], Bomin Seo[1], Taemin Shin[1]
[1]Department of Biomedical Engineering, Yonsei University, Wonju, Korea

IP-023

Development of an auxiliary tool for objective consciousness assessment in patients with brain disease

Yeoeun Choi[1], Sanghoon Nam[1], and Taemin Shin[1]
[1]Yonsei University

IP-024

Design Techniques for Multi-Channel Instrumentation Amplifiers for Biomedical Applications

Junbeom Park[1], Jeong Hoan Park[2], Tao Tang[2], Lian Zhang[2], Kian Ann Ng[3], Hyoungjoon Kim[1], and Jerald Yoo[1*]
[1]Department of Electrical and Computer Engineering, Seoul National University, Seoul, Korea.
[2]Dept. of ECE, National University of Singapore
[3]N.1 Institute for Health, Singapore

IP-025

Soft, Skin-Interfaced, Wireless Multi-Channel EMG Monitoring and Analyzing System for Rehabilitation Exercise Assistance

Sumin Kim[1,2], Seunghun Han[1,2], and Jahyun Koo[1,2*]
[1]School of Biomedical Engineering, College of Health Science, Korea University
[2]Interdisciplinary Program in Precision Public Health, Korea University

IP-026

High-throughput screening system for immunogenic cell death inducers based on AI real-time image analysis

Eunseo Kim[1*], Minji Kim[1*], Donghoon Jang[2*], Jiwon Heo[3*], Minji Choi[1], Jisoo Shin[1], Youngbin Seo[1], Daeun Lee[1], Jaehyeon Yoo[1], Hyungyu Lee[5#], Jong-Ho Cha[1,4]
[1]Department of Biomedical Science, Program in Biomedical Science and Engineering, Graduate school, Inha University
[2]Department of Electrical and Computer Engineering, Inha University
[3]Department of Computer Science, Inha University
[4]Department of Biomedical Science, Inha University
[5]Department of Medical Education and Medical Humanities, College of Medicine, Inha University

IP-027

Transfer Learning-Based Approaches for Predicting Parkinson's Disease Using REM EEG Signals

Somin Oh[1], Hyeyoun Cho[1], Rumana Ferdushi[1], Yoonho Hwang[1], Erdenebayar Urtnasan[2], Jaehong Key[1*]
[1]Department of Biomedical Engineering, Yonsei University, Korea
[2]Institute of AI Data Convergence Science, Yonsei University Mirae Campus, Korea

IP-028

Development of a Deep Learning Algorithm for Major Depressive Disorder Diagnosis Based on Lifelog Data

Jaehoon Ko[1], Hyeyoun Cho[1], Rumana Ferdushi[1], Yoonho Hwang[1], Erdenbayar Urtnasan[2,3], Jaehong Key[1]
[1]Department of Biomedical Engineering, College of Sotfware Digital Health Convergence, Yonsei University, Korea
[2]Institute of Yonsei AI Data Convergence Science, Yonsei University, Korea
[3]Artificial Intelligence Big Data Medical Center, Wonju College of Medicine, Yonsei University, Korea

IP-029

Generalized ECG Feature Learning and Arrhythmia Classification Using Contrastive Predictive Coding

Hyeonjung Kim[1†], Youngshin Kang[1], Geunbo Yang[1], Jong Seon Lee[2] and Cheolsoo Park[1*]
[1]Department of Computer Engineering, Kwangwoon University,Seoul
[2]Holmes AI, Daegu, KR 41260, Republic of Korea

IP-030

Pancreatic Cancer Segmentation Using a Hybrid CNN-Transformer Model on CT Scan Images

Nirmal Adhikari[1], Tursunbaev Chingiz[2], SeungKyu Oh[3], Toshboev Bobomurot[4], and Wookey Lee[5*]
[1,2,4,5]Biomedical Science and Engineering Department, Inha University, Korea
[3]Industrial Engineering Department, Inha University, Korea.

IP-031

Recent Dataset and Machine Learning Techniques for ADL Recognition Using Wrist-worn Accelerometer Data

Hyeyeon Kim[1], Jongmo Seo[1,2*]
[1]Department of Electrical and Computer Engineering, Seoul National University
[2]Biomedical Research Institute, Seoul National University Hospital

IP-032

Predicting Heart Disease Risk Using Demographic, Lifestyle, Socioeconomic, and Psychological Factors: A Machine Learning Approac

Toshboev Bobomurot[1], Nirmal Adhikari[1], Tursunbaev Chingiz[1], Abdusattorov Umid[3], Kim Gwangsoo[2], Wookey Lee[1,2]
[1]Department of Biomedical Science and Engineering, INHA University, Incheon, Korea
[2]Department of Industrial Engineering, INHA University, Incheon, Korea
[3]Department of Rehabilitation, Multidisciplinary clinic of Tashkent Medical Academy, Tashkent, Uzbekistan

IP-033

Hybrid Neural Network Model for Anomaly Detection in Implantable Devices Using Graph Attention Networks and Transformers

Dongwook Kwon[1], Minji Kim[1], Youngshin Kang[1], Jihong Lee[1], and Cheolsoo Park[1*]
[1]Department of Computer Engineering, Kwangwoon University

IP-034

Application of remote heart rate estimation on a treadmill using a mixture of expert-based time series transformer model

Yusang Nam[1], Junghwan Lee[1], Hyuentae Lee[1] and Cheolsoo Park[1*]
[1]Department of Computer Engineering, Kwangwoon University

IP-035

Citric Acid Disassembles α–Synuclein Fibrils and Reduces Their Cytotoxicity

Yeon Ho Kim[1,2], Hyo Gi Jung[1,2], and Dae Sung Yoon[1,2*]
[1]Department of Biomedical Engineering, Korea University, Seoul, Korea
[2]Interdisciplinary Program in Precision Public Health, Korea University, Seoul, Korea.

IP-036

Comparative Evaluation of Neural Network Architectures for Automated Sleep Stage Classification Using EEG and EMG Signals

Jinyoung Choi[1], Hankil Oh[2], Minkyu Ahn[2*]
[1]Massachusetts General Hospital, Harvard Medical School, Boston, MA, United States
[2]School of Computer Science and Electrical Engineering, Handong Global University,Pohang, South Korea

IP-037

The relationship between body mass index and brain volume

Yubin Oh[1], Junbeom Lee[1], Jonghun Lee[1], Dohyun Kim[1], Yechan Kim[1], Wonpil Jang[1], Wanhyung Lee[2], Joon Yul Choi[1*]
[1]Department of Biomedical Engineering, Yonsei University
[2]Department of Preventive Medicine, College of Medicine, Chung–Ang University

IP-038

Impact of Segmentation Improvement on White Blood Cell Counting Accuracy

Jihong Lee[1], Youngshin Kang[1], Minji Kim1, Jihwan Won[1], Dongwook Kwon[1] and Cheolsoo Park[1*]
[1]Department of Computer Engineering, Kwangwoon University

IP-039

Tunable SHEL Based on ITO Metasurface for Chiral Molecules Detection

Sangmin Shim[1], Kyunghyun Yu and Dasol Lee[1*]
[1]Department of Biomedical Engineering Yonsei University, Wonju

IP-040

Radiative cooling fiber for thermal management of wearable healthcare devices

Changhwan Hyeon[1], Minseo Jeong[1], Seokgyu Kwon[1], Dasol Lee[1*]
[1]Department of Biomedical Engineering Yonsei University, Wonju

IP-041

Metasurface–Based Lens Design for Rigid Endoscopic Laser Device

Kyunghyun Yu[1], Sangmin Shim and Dasol Lee[1*]
[1]Department of Biomedical Engineering Yonsei University, Wonju.

IP-042

Radiative Cooling Nanofiber Materials with Menthol for Pruritus Relief and Skin Cooling in Atopic Dermatitis

Minseo Jeong[1], Seokgyu Kwon[1], Changhwan Hyeon[1] and Dasol Lee[1*]
[1]Department of Biomedical Engineering Yonsei University, Wonju.

IP-043

Enhanced Energy Delivery Using Optical Fibers Integrated with Medical Needles for Advanced Low-Level Laser Therapy

Donghwan Ko[1], Seyoung Lee[1], Hyunseon Yu[1], and Byungjo Jung[1*]
[1]Department of Biomedical Engineering Yonsei University, Wonju.

IP-044

Facile synthesis of multi-stimuli responsive biocompatible trimethyl chitosan-based nanogel as potential nanocarrier for photothermal chemotherapy

Jun Hyeon Park[1], Su-Geun Yang[1]
[1]Department of Biomedical Science, BK21 FOUR Program in Biomedical Science and Engineering, College of Medicine, Inha University

IP-045

Laser Speckle Contrast Imaging for Implementation of Portable Optical Imaging System

Hyunseon Yu[1], Donghwan Ko[1], Seyoung Lee[1], and Byungjo Jung[1]
[1]Department of Biomedical Engineering, Yonsei University, Wonju

IP-046

Kctd17 as a novel target for the treatment of hepatocellular carcinoma

Yun Ji Lee[1,2,3], Sang Eun Kim[1,2,3], Young Hoon Jung[1,2,3], Kyung Hee Jung[1,3], Ah-Reum Oh[1,2,3], Yelin Jeong[1,2,3], HyunJoon Gi[1,2,3], Young Un Kim[1,2,3], KyeongJin Kim[1,2,3], Soon-Sun Hong[1,2,3*]
[1]Department of Biological Sciences, College of Medicine, Inha University
[2]Program in Biomedical Science & Engineering, Inha University
[3]Research Center for Controlling Intercellular Communication (RCIC), College of Medicine, Inha University

IP-047

Neural Electrode Fabrication Using Spin-Coated COC Film

Hwi Ahn[1], Jong-Mo Seo[1,2*]
[1]Department of Electrical and Computer Engineering, Seoul National University
[2]Biomedical Research Institute, Seoul National University Hospital

IP-048

Core-Shell Nanofiber Tracheal Stent for Doxycycline Delivery: Inhibiting Metalloproteinase and Fibrosis Formation

Ngoc Thuan Truong[1], Su-Geun Yang[1*]
[1]Department of Biomedical Science, BK21 FOUR Program in Biomedical Science and Engineering, College of Medicine, Inha University

IP-049 Analyzing the relationship between performance of ML and interpretability

Youngro Lee[1], Jongmo Seo[1,2*]
[1]Electrical and Computer Engineering, Seoul National University
[2]Biomedical Research Institute, Seoul National University

IP-050 Comparison of Decision Tree Classification Algorithms on EEG Data

Nayeon Lee and Jongmo Seo[1]
[1]Electrical and Computer Engineering, Seoul National University

IP-051 Development of a Portable Near-infrared Imaging Device for Induction and Detection of Autofluorescence in Parathyroid Glands during Surgery

Buri Kim[1], Jong-Hyuk Ahn[2], Kyu Eun Lee[3], Changhoon Baek[1*]
[1]Department of Transdisciplinary Medicine, Seoul National University Hospital, Seoul, Korea
[2]Department of Surgery, Chung-Ang University Hospital, Seoul, Korea
[3]Department of Breast and Endocrine Surgery, Seoul National University Hospital, Seoul, Korea

IP-052 Improvement of fall risk prediction using the short-form berg balance scale for self-assessment

Bo Bo kyaw[1], Jinseok Park[1], Suvin Lee[1], Yerim Shin[1], Byeonghee Kim[1], Tejin Yoon[1,*]
[1]Department of Smart Health Science and Technology, Kangwon National University, Chuncheon,

IP-053 Personal Identification Based on Footstep Sounds Using Machine Learning and MFCC

J. H. Hwang[1], Y. H. Kim[1], S. T. Sneha[1], S. Y. Choi[1], J. W. Lee[2], and Y. J. Park[1,2*]
[1]Department of Smart Health Science and Technology, Kangwon National University, Chuncheon, Korea
[2]Department of Mechanical and Biomedical, Mechatronics Engineering, Kangwon National University, Chuncheon, Korea.

Poster

Mitigate effects of cytotoxicity and inhibition of NF-κB expression following PEMF stimulation in inflammatory response of HaCaT cells induced by TNF-α/IFN-γ

Jun-Young Kim[1], Chan-Ho Park[1], and Yong-Heum Lee[1]*

Biomedical Electromagnetic System Laboratory, Department of Biomedical Engineering, Yonsei University, Wonju 26493, Korea

*E-mail: koaim@yonsei.ac.kr

Skin keratinocytes, which form the outer epidermis composed of the middle layer squamous epithelium, are directly exposed to antigens and are involved in inflammatory and immune reactions by producing various inflammatory mediators such as cytokines and chemokines [1]. If skin keratinocytes are continuously exposed to external stressors, resistance to external antigens is greatly reduced, and excessive secretion of infectious cytokines such as Tumor necrosis factor (TNF)-α and Interferon (IFN)-γ induces infiltration of T-cells and white blood cells [2]. However, in the case of drug treatment that has been used so far, it is impossible to cure it and the improvement level due to drug resistance gradually decreases, which can lead to various side effects due to increased drug input. Therefore, research is needed on new alternative means that can overcome the limitations of drug treatment. In this study, through Pulsed electromagnetic fields (PEMF) stimulation, which was found to be effective in anti-inflammatory and tissue regeneration through previous studies, the anti-inflammatory effect and PEMF stimulation were observed to observe the side effects of electromagnetic stimulation. CCK-8 assay was performed to determine whether the survival rate of PEMF stimulation time on keratinocytes decreased, and based on this, NF-κB signaling, which is found in almost all animal cells and plays a major role in inflammatory reactions, was observed.

Acknowledgement : This research was supported by the “Regional Innovation Strategy (RIS)” through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (MOE) (2022RIS-005) and BK21Four (Education and Research Center of NBIT-integrated Medical System for Personalized Healthcare, NO.5120200613633) Program through the National Research Foundation of Korea(NRF) funded by the Ministry of Education.

References

[1] Cho, S-H. et al. *International Immunophamacology 82*, 106-146 (2020)
[2] Yang, J-H. et al. *Phytomedicine 22*, 1262-1268 (2015)

Keywords: HaCaT Cell, TNF- α, IFN-γ, NF-κB, and PEMF.

Development of Silk Protein Composite-Based Paclitaxel-Loaded Nanoparticles and Evaluation of Anticancer Effects on Cervical Cancer Cells

Yoonho Hwang[1], Hyeyoun Cho[1], Jaehoon Ko[1], Rumana Ferdushi[1], Jaehong Key[1*]

[1]Department of Biomedical Engineering, Yonsei University, Wonju, Korea

[*]E-mail: jkey@yonsei.ac.kr

Cervical cancer remains a significant health concern for women globally, with notably high incidence rates in developing countries. Moreover, hundreds of thousands of women are diagnosed with this malignancy annually[1]. Paclitaxel (PTX) is a widely used chemotherapeutic drug for the cervical cancer; however, its low bioavailability, hydrophobic nature, and associated side effects, including toxicity to healthy tissues, have driven the demand for innovative drug delivery systems. In this study, we propose a novel paclitaxel-loaded nanoparticle (SSSF-PTX NP) based on a composite of silk fibroin (SF) and silk sericin (SS), aiming to enhance the delivery efficiency of PTX and mitigate its adverse effects. The results showed that the SSSF-PTX nanoparticles had an average particle size of 288.3±2.53 nm and a zeta potential of -27.21±2.401 mv, with 52.31±0.959 % of PTX loaded into the nanoparticles. In cell viability assays, HeLa cells exhibited more than 50% cell death at a PTX concentration of 0.3 μM, while SiHa cells did not show significant cytotoxicity under the same conditions. Moreover, the SSSF nanoparticles without PTX did not exhibit any cytotoxic effects, indicating that SSSF is a biocompatible and safe drug delivery vehicle. This study demonstrates the potential of SSSF-PTX nanoparticles as an effective drug delivery platform for cervical cancer therapy. Further in-vivo studies are needed to evaluate the therapeutic efficacy and safety of these nanoparticles in clinical applications

Acknowledgement: This work was supported by the National Research Foundation of Korea (NRF). (No.2022R1F1A1069516)

References

[1] Ali, Rainer Kuelker, B. Wassie, *Annals of Tropical Medicine and Public Health, 5*, 3-15 (2012)

[2] Liu Y, et al., *Mini Rev Med Chem, 3,* 1780-1796 (2023)

Keywords: Cervical cancer, Paclitaxel, Silk protein, Nanoparticle, Drug delivery systems

Development of silk protein-based drug delivery system for lung cancer treatment

Hyeyoun Cho, Rumana Ferdushi, Yoonho Hwang, Jaehoon Ko and Jaehong Key*

Department of Biomedical Engineering, Yonsei University, Korea

*E-mail: jkey@yonsei.ac.kr

This study aimed to enhance the efficacy of metastatic lung cancer treatment through the development of a silk protein-based drug delivery system. Utilizing Silk Sericin (SS) and Silk Fibroin (SF), discoidal polymeric particles loaded with the chemotherapy agent Docetaxel (DTX) were fabricated, measuring 3μm in size. These particles were characterized morphologically using Scanning Electron Microscopy (SEM) and Confocal Microscopy. Animal experiments confirmed the effective distribution of particles within lung tissue and their tumor-suppressing capabilities, while histological analyses verified the safety and efficacy of the drug delivery system. The particles rapidly accumulated in the lung, minimizing dispersion to other organs and reducing the potential for side effects. These results demonstrate the significant therapeutic potential of silk protein-based drug delivery systems for lung cancer treatment. This research suggests a new method for cancer treatment that reduces drug-induced side effects, ensures efficient drug release, and maintains sustained therapeutic effects.

Acknowledgement :

This work was supported by National Research Foundation of Korea (NRF) grants funded by the Korean government (grant nos. 2022RIS-005, 2022R1F1A1069516) and Korea Institute of Science and Technology intramural research grant (2Z07014).

References (Maximum 2 References)

[1] P. Decuzzi, et al., Journal of Controlled Release, 141, 320-327 (2010).
[2] Y. Ma, et al., Frontiers in Chemistry, 8, 585077 (2020).

Keywords: Drug Delivery System, Silk Protein, Microparticles

Safeguarding Hearing from Loss with the Use of Fucoidan loaded SPIONs and Dexamethasone Nanoparticles Delivered through Magnetic Attraction

Rumana Ferdushi, Hyeyoun Cho, Yoonho Hwang, Jaehoon K, Jaehong Key

Department of Biomedical Engineering, Yonsei University, Republic of Korea *
*E-mail: jkey@yonsei.ac.kr

Currently, no effective treatment exists for ototoxicity other than discontinuing the medication. The inner ear's limited regenerative capacity makes hair cell damage caused by ototoxicity irreversible. Dexamethasone (Dexa), a synthetic steroid, shows promise in protecting hearing but suffers from poor absorption due to the blood-labyrinth barrier (BLB). Nanoparticles offer a potential solution by enhancing drug delivery, prolonging drug release, and minimizing side effects. This study explores Fucoidan-SPIO nanoparticles combined with Dexa to counteract ototoxicity. Fucoidan, a natural antioxidant from seaweed, has been shown to reduce oxidative stress. Fucoidan and PEI solutions were mixed with iron cores and processed to create nanoparticles, which were then tested on UB/OC-2 cells. Cells treated with Fucoidan before cisplatin exposure showed improved viability and lower ROS levels, indicating reduced oxidative stress. Fucoidan-SPIO nanoparticles enhanced cell survival and migration under stress, as well as reduced ROS levels via apoptosis-related pathways. These nanoparticles remained stable in water for 24 hours and after freezing for 15 days.Our findings suggest that Fucoidan-SPION combined with Dexa and a magnetic field can prevent hearing loss from ototoxicity through anti-apoptotic mechanisms, highlighting its potential as a therapeutic option.

Acknowledgement : This work was supported by the National Research Foundation of Korea (NRF) (NRF-2020R1A2C3010322).

References

[1] Sun, Changling, et al. "Dexamethasone loaded nanoparticles exert protective effects against Cisplatin-induced hearing loss by systemic administration." *Neuroscience letters* 619 (2016): 142-148.

Keywords: Ototoxicity, Nanoparticles, Dexamethasone, SPIO (Superparamagnetic Iron Oxide)

PVA/SiO_2/CA electrospun nanofiber with radiative cooling

Seokgyu Kwon[1], Changhwan Hyeon[1], Minseo Jeong[1], Dasol Lee[1]*

[1] Department of Biomedical Engineering Yonsei University, Wonju, Republic of Korea

*E-mail: dasol@yonsei.ac.kr

Global warming has emerged as one of the most critical challenges of our time, leading to increased heat illnesses such as heat stroke or heat exhaustion. To address this pressing issue, it is essential to explore sustainable methods that decrease temperature. Radiative cooling presents a promising solution that reduces heat by decreasing the temperature below the surrounding temperature without consuming other energy resources or external energy usage. In this study, we developed radiative cooling nanofibers composed of polyvinyl alcohol (PVA), silicon dioxide (SiO_2), and citric acid (CA) using the electrospinning technique. Based on previous research that involved radiative cooling nanofibers with PVA and SiO_2 [1], we introduced citric acid as a crosslinking agent to further improve the functionality of the nanofibers. PVA is widely recognized as a biocompatible polymer, making it a promising candidate for various biomedical applications. However, its high solubility in aqueous environments presents a significant limitation. The addition of CA promotes crosslinking with PVA, resulting in enhanced water resistivity of the nanofiber. In addition, the CA also improves the swelling degree, which can control drug release in drug delivery systems [2]. It is anticipated that this radiative cooling nanofiber has considerable potential for application not only as a material but also as a platform for drug delivery systems.

References

[1] Zhu, H. et al. “Electrospun poly(vinyl alcohol)/silica film for radiative cooling.” Advanced Composites and Hybrid Materials 5, 1966–1975 (2022).
[2] Xing, G., Shao, L., Du, Y., Tao, H. & Qi, C. “Citric acid crosslinked chitosan/poly(ethylene oxide) composite nanofibers fabricated by electrospinning and thermal treatment for controlled drug release.” *Cellulose* **28,** 961–971 (2021)

Keywords: Electrospinning, radiative cooling, nanofiber, biomaterial

Tau oligomer-degrading drug discovery platform using tau amyloid corona-shelled nanoparticles

Junho Bang[1,2], Hyo Gi Jung[1,2], Dae Sung Yoon[1,2,*]

[1]School of Biomedical Engineering, Korea University, Seoul 02841, Republic of Korea
[2]Interdisciplinary Program in Precision Public Health, Korea University, Seoul 02841, Republic of Korea

[*]E-mail: dsyoon@korea.ac.kr

Tau oligomers are recognized for their critical role in causing neuronal toxicity and synaptic dysfunction in a diverse array of neurodegenerative diseases collectively referred to as tauopathies. However, the discovery of drugs that specifically target tau oligomers has been impeded by the absence of appropriate screening methods. Here, we suggest a drug screening platform based on tau amyloid corona-shelled nanoparticles (TACONs) to assess the efficacy of tau oligomer-degrading compounds through aggregation-induced colorimetric responses of TACONs. TACONs were engineered via the encapsulation of gold nanoparticles with homogeneous tau oligomers by leveraging heparin as a co-factor. Further, to validate the proposed strategy, we employed proteases that can degrade tau oligomers (protease XIV and plasmin) along with various small molecules known to aid in the treatment of tauopathies. We demonstrated that the proposed strategy with TACON can discover tau oligomer-degrading agents, thereby potentially reducing the attrition issues encountered in drug discovery for tauopathies.

Acknowledgement : This work was supported by National Research Foundation of Korea (NRF) grants funded by the Korean Government (MSIP) (grant numbers: NRF-2022R1A2C1091756, NRF-2022R1A6A3A03066467, and RS-2024-00400563) and the BK21 FOUR Institute of Precision Public Health.

References

[1] Guo, T., Noble, W., & Hanger, D. P. (2017). Roles of tau protein in health and disease. *Acta neuropathologica*, *133*, 665-704.
[2] Lee, D., Park, D., Kim, I., Lee, S. W., Lee, W., Hwang, K. S., ... & Yoon, D. S. (2021). Plasmonic nanoparticle amyloid corona for screening Aβ oligomeric aggregate-degrading drugs. *Nature communications*, *12*(1), 639.

Keywords: Drug screening, Tau oligomer, Neurodegenerative disease, Plasmonic, Nanoparticle

Wet spinning of cellulose nanofibrils toward biomedical applications

Gyuhui Park[1] and Bong Sup Shim[1, 2*]

[1] Program in Biomedical Science & Engineering, Inha University, South Korea
[2]Department of Chemical Engineering, Inha University, South Korea

[*]E-mail: bshim@inha.ac.kr

Over the past decade, there has been significant growth in the use of fiber-based products and structures for biomedical applications. Wet spinning has emerged as a fundamental method for fabricating fibrous structures with consistent fiber size and excellent mechanical properties. Nanocellulose, known for its lightweight, high strength, good biocompatibility, and easy chemical modification is particularly promising. In this study, we fabricated nanocellulose-based microfibers from CNF dispersion via wet spinning coagulated in various metal ion solution baths, to investigate their potential for biomedical applications. We explore the influence of different metal ion environments on the morphology, mechanical properties, and surface characteristics of the resulting nanocellulose filaments. Furthermore, the application potential of nanocellulose-based microfibers in tissue engineering, wound healing, and drug delivery systems are proposed. This approach integrates superior physical properties of nanocellulose with dynamic crosslinking mediated by metal ions, presenting a promising avenue for developing advanced biomaterials in the medical field.

Keywords: Cellulose nanofibril (CNF), Metal ion-crosslinking, Wet spinning, Biocompatibility, Biomaterials

Fabrication process of 3D plateau structure implatable PFA-based electrodes for effective stimulation

Jiseon Lee[1], Jisung Kim[2], Buri Kim[2] and Jongmo Seo[1,3,*]

[1]Department of Electrical and Computer Engineering, Seoul National University, Korea
[2]Department of Transdisciplinary Medicine, Seoul National University Hospital, Korea
[3]Biomedical Research Institute, Seoul National University Hospital, Korea

*E-mail: callme@snu.ac.kr

The demand for implantable electrodes in the human body has steadily increased following the success of cardiac pacemakers and cochlear implants. [1] In this study, we fabricated PFA film-based electrodes in 3D form for more effective stimulation. A 50 μm thick PFA film was sonicated in ethanol and subsequently dried. The dried film was then sandwiched between a 500 μm thick PTFE and a 50 μm thick PTFE, followed by pre-thermal pressing in a molded aluminum jig. The pressing was conducted at 200°C for 1 hour, followed by slow cooling while additional weight are applied to minimize alignment issues caused by the thermal shrinkage. Through this process, the stimulation sites were thermally molded into a plateau shape with a height of 150 μm. The diameter of elevated stage is 250 μm, with a base diameter of 350 μm. The electrode includes 20 channels, and its thickness is 70 μm. The pre-pressed PFA film was attached to a dummy silicon wafer using resin release tape, followed by surface treatment with argon plasma. Subsequently, metal layers were deposited using an e-gun evaporator and patterned using an aligner. After electroplating and etching, the electrodes were thermally laminated with an additional site-opened bare PFA film. Ex vivo experiments will be conducted to stimulate the subretinal tissue layer and compare the stimulation efficiency of the 3D electrodes with that of planar electrodes.

Acknowledgement : This research was supported by a grant of the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea (grant number : RS-2023-00304861)
This work was supported by the National Research Foundation of Korea(NRF) grant funded by the Korea government(MSIT) (No. 2022R1F1A1059705).
This work was supported by the Institute of Information & Communications Technology Planning & Evaluation(IITP)-Global Data-X Leader HRD program grant funded by the Korea government(MSIT)(IITP-2024-00441407).
This research was supported by a grant of 'Korea Government Grant Program for Education and Research in Medical AI' through the Korea Health Industry Development Institute(KHIDI), funded by the Korea government(MOE, MOHW).

References

[1] Rouhollah Jalili, Aswini Kanneganti, Mario I. Romero-Ortega, Gordon G. Wallace. *Implantable 3*, 68-74 (2017)

Keywords: Electrodes, implantable, 3D, plateau, PFA

Optimized site opening in COC-based neural electrodes for retinal implants using reactive ion etching (RIE)

Taekyung Lee1, Joowon Lee1, Jong-Mo Seo1,2*

[1]Department of Electrical and Computer Engineering, Seoul National University, Korea
[2]Biomedical Research Institute, Seoul National University Hospital, Korea

*E-mail: callme@snu.ac.kr

Retinal prostheses are neural devices designed to restore vision in patients with degenerative retinal diseases like age-related macular degeneration (AMD) and retinitis pigmentosa (RP). These devices rely on electrodes that stimulate retinal cells, requiring substrates that are biocompatible, moisture-resistant, and transparent. In this study, cyclic olefin copolymer (COC) was used as the substrate material for neural electrodes.
COC was chosen for its biocompatibility and low moisture absorption. COC films, composed of a 40 μm substrate and 20 μm lamination layers, were created using a hydraulic hot press and patterned using photolithography. For site opening, reactive ion etching (RIE) was chosen for its precision. A gas mixture of O_2, CF_4, and CHF_3 at 80, 10, and 10 sccm, respectively, was used. A 200 nm aluminum layer was applied as a mask to protect non-site areas during etching.
After optimizing the RIE conditions, the etch rate increased from 7 μm/h to 13 μm/h, and SEM images confirmed anisotropic etching with well-defined sidewalls. This control over the etching process ensures the fabrication of precise COC-based electrodes, essential for high-density neural arrays. The study demonstrates that RIE is effective for site opening in COC-based electrodes, providing both speed and precision, crucial for the development of retinal prostheses.

Acknowledgement : This research was supported by a grant of the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea (grant number : RS-2023-00304861). This work was supported by the Institute of Information & Communications Technology Planning & Evaluation (IITP)-Global Data-X Leader HRD program grant funded by the Korea government (MSIT)(IITP-2024-00441407) This research was supported by a grant of 'Korea Government Grant Program for Education and Research in Medical AI' through the Korea Health Industry Development Institute (KHIDI), funded by the Korea government (MOE, MOHW).

References

[1] Wu, Kevin Y. et al., Retinal Prostheses: Engineering and Clinical Perspectives for Vision Restoration, Sensors, 23.13 (2023): 5782.

Keywords: Retinal prosthesis, Neural electrode, electrode fabrication

Impact of Oxygen Plasma Treatment on Surface Properties and Metal Adhesion of Cyclic Olefin Copolymer (COC)

Joowon Lee[1], Taekyung Lee[1], Jong hyeon Lee[2], and Jong-mo Seo[1,3,*]

[1]Electrical and Computer Engineering, Seoul National University, Korea
[2]Department of Transdisciplinary Medicine, Seoul National University Hospital, Korea
[3]Biomedical Research Institute, Seoul National University Hospital, Korea

[*]E-mail: callme@snu.ac.kr

Cyclic olefin copolymer (COC) is a thermoplastic polymer known for its high transparency, low moisture permeability, chemical stability, and biocompatibility making it suitable for biomedical applications such as packaging and implantable electrodes. However, its chemical stability limits surface reactivity, which hinders the adhesion of matals like gold, essential for circuit patterning. Oxygen plasma treatment is widely used to enhance surface adhesion by introducing oxygen-containing functional groups and increasing surface roughness. This process strengthens bonding, but excessive plasma exposure can cause surface degradation, leading to poor adhesion, oxidation, and mechanical defects.

In this study, COC films underwent oxygen plasma treatment under six different conditions to identify the optimal parameters for gold deposition. The treatment at 50 W for 180 seconds resulted in the lowest sheet resistance, indicating the best adhesion. In contrast, the 50 W for 600 seconds condition led to a pinkish hue in the gold layer, suggesting oxidation of gold and increased sheet resistance. Atomic force microscopy (AFM) revealed that surface roughness increased with plasma intensity, but this effect diminished with longer treatment times, indicating a saturation point. These findings highlight the critical balance between enhancing adhesion and maintaining surface integrity through controlled plasma treatment.

Acknowledgement : This work was supported by the National Research Foundation of Korea(NRF) grant funded by the Korea government(MSIT) (No. 2022R1F1A1059705). This research was supported by a grant of the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea (grant number : RS-2023-00304861). This work was supported by the Institute of Information & Communications Technology Planning & Evaluation(IITP)-Global Data-X Leader HRD program grant funded by the Korea government(MSIT)(IITP-2024-00441407). This research was supported by a grant of 'Korea Government Grant Program for Education and Research in Medical AI' through the Korea Health Industry Development Institute(KHIDI), funded by the Korea government(MOE, MOHW).

References (Maximum 2 References)

[1] Nikolova, D. et al., Surface and Interface Analysis, **36(8)**, 689 – 693 (2004).
[2] Brisset, F. et al., Applied Surface Science, **329.**, 337-346 (2015).

Keywords: Cyclic olefin copolymer, Atomic force microscopy, oxygen plasma treatment

Fabrication of functionally graded multi-ceramic structure using digital light processing (DLP) 3D printing technique with passive in-line mixing concept

Gyu-Nam Kim[1,2], Jae-Min Jung[1,2], Jae-Hyung Park[1,2], Jun-Sik Kim[1, 2], Jae-Uk Song[1,2], Nelly Aimelyne Mpuhwe[1,2], Young-Hag Koh[1, 2, *]

[1]School of Biomedical Engineering, Korea University, Seoul, Korea
[2]Interdisciplinary Program in Precision Public Health, Korea University, Seoul, Korea.

*E-mail: kohyh@korea.ac.kr

To fabricate multi-ceramic material structure in a gradient manner based on the digital light processing (DLP) principle, a novel 3D printing technique with passive mixing system was developed. 4-mol% and 5-mol% yttria partially stabilized zirconia (PSZ) materials were used to additively manufacture functionally graded material (FGM) ceramic parts. With in-line mixing concept using static mixer being adopted to DLP 3D printing technique, FGM structure was created with using two different ceramic suspensions. In the process, the extrusion ratio of both suspensions are controlled, which flows through a static mixer attached onto custom-built DLP 3D printer. After extrusion, layers of suspensions are solidified in a functionally graded manner at stacking direction, hence, compositionally graded zirconia products are fabricated [1]. Besides to the printing technique, two highly-loaded suspensions with 50 vol% were prepared to obtain similar viscosity and curing behavior by powder modification and suspension optimization. Furthermore, to fully prove the gradient within a single printed body, comprehensive mechanical, optical and microstructural analysis were performed to demonstrate controlled compositional change according to the initial design.

Acknowledgement : This research was supported by the Technology Innovation Program (Contract No. 20001155, Development of highly Transluscent/Tough Ceramic Materials and Manufacturing Technique for Tailor-made Crown) funded by the Ministry of Trade, industry & Energy (MI, Korea), and BK21 FOUR (BrainKorea21 Fostering Outstanding Universities for Research) funded by the Ministry of education and National Research Foundation of Korea (NRF)

References (Maximum 2 References)

[1] H. Xing, B. Zou, X. Liu, X. Wang, C. Huang, Y. Hu, J. Eur. Ceram. Soc., 44, 5797-5809 (2020)

Keywords: Functionally graded materials, Zirconia, Additive manufacturing, Digital light processing

Manufacturing and Characterization of Dental Crowns Made of 5-mol% Yttria Stabilized Zirconia by Digital Light Processing

Jae-Min Jung[1, 2], Gyu-Nam Kim,[1, 2], G, Jae-Hyung Park[1, 2], Jae-Uk Song[1, 2], Jun-Sik Song[1, 2], Nelly Aimelyne Mpuhwe[1, 2] and Young-Hag Koh[1, 2, *]

[1]Department of Biomedical Engineering, Korea University, Seoul, Korea
[2]Interdisciplinary Program in Precision Public Health, Korea University, Seoul, Korea.

[*]E-mail: optima3000@hanmail.net

Bio-ceramics such as alumina, calcium phosphate, and zirconia have been employed in medical and dental industry due to their distinctive characteristics. Especially for artificial crowns in dental applications, crowns made of yttria stabilized zirconia have exhibited extraordinary mechanical performances and esthetic satisfaction compared to those made of traditional materials such as gold and porcelain [1]. In view of that, various methods to manufacture zirconia crowns have been developed including computer-aided design/ computer-aided manufacturing (CAD/CAM) and vat polymerization like stereolithography (SLA) or digital light processing (DLP). In particular, a tape-casting based DLP is appropriate for relatively high solid loading suspensions which are rarely utilized by conventional DLP. In this paper, we herein carefully optimized processing parameters for tape-casting based DLP process to manufacture 5Y-PSZ dental crowns with desired mechanical properties, optical translucency, and dimensional accuracies. The use of a high solid loading of 50 vol% in 5Y-PSZ suspensions allowed sintered 5Y-PSZ to have high relative densities (98.93 ± 0.39 %), thus offering high flexural strength (625.4 ± 75.5 MPa) and optical transmittance (35 ± 1.2). In addition, high dimensional accuracy (RMS for marginal discrepancy = 44.4 ± 10.8 μm and RMS for internal gap = 22.8 ± 1.6 μm) was achieved by precisely designing initial dimensions of dental crowns and photocuring time for 3D printing.

Acknowledgement : This research was supported by the Technology Innovation Program (Contract No. 20001155, Development of highly Translucent/Tough Ceramic Materials and Manufacturing Technique for Tailor-made Crown) funded by the Ministry of Trade, industry & Energy (MI, Korea), and BK21 FOUR (BrainKorea21 Fostering Outstanding Universities for Research) funded by the Ministry of education and National Research Foundation of Korea (NRF).

References (Maximum 2 References)

[1] Kim, J.H.; Maeng, W.Y.; Koh, Y.H.; Kim, H.E., *Ceram. Int*. 46 (2020) 28211-28218.

Keywords: 3D printing, digital light processing, zirconia, dental crowns, strength

Bio-inspired calcium phosphate scaffolds with dual-scale porosity honeycomb cores surrounded by dense shells using phase-separation assisted DLP

Jae-Uk Song[1,2], Gyu-Nam Kim[1,2], Jae-Min Jung [1,2], Jae-Hyung Park [1,2] Nelly Aimelyne Mpuhwe [1,2] Jun-Sik Kim [1,2], Young-Hag Koh[1,2,*]

[1]School of Biomedical Engineering, Korea University
[2]Interdisciplinary Program in Precision Public Health, Korea University

[*]E-mail: kohyh@korea.ac.kr

The combination of a dense outer layer and a porous inner structure, commonly observed in natural materials like bone, is crucial for providing both mechanical strength and biological functionality. This dual structure is essential for supporting physical loads while promoting cell growth and nutrient exchange, which is vital for effective tissue regeneration. However, there is a lack of additive manufacturing techniques that can achieve it, especially in ceramics. So, herein, we introduce a novel digital light processing (DLP) ceramic additive manufacturing technique for locally controlled dense and porous microstructures. By integrating DLP 3D printing with the freeze casting method, we created dual-scale porous honeycomb cores surrounded by dense shells. Biphasic Calcium Phosphate (BCP), which closely resembles natural bone, was used as the starting material, Camphene was used as a porogen. Pores formed in the camphene/photopolymer system through thermally induced phase separation. The core with a honeycomb strucuture w/ phase separation features both macro-scale and micro-scale pores. Conversely, the outer shell w/o phase separation remains dense. This method can produce two distinct structures from a single material.

Acknowledgement : This work was supported by the BK21 FOUR (BrainKorea21 Fostering Outstanding Universities for Research) funded by the Ministry of education and National Research Foundation of Korea (NRF).

References

[1] Choe, G. *Addit. Manuf. 85* (2024)
[2] Kim, I. *Addit. Manuf.* 52 (2022)

Keywords: Vat photopolymerization, Ceramics, Phase separation, Dual-scale porosity, Crystallization.

Development of Antibacterial Resin Composite for DLP 3D Printing Applications Using CeO_2 Nanoparticles

Jun-Sik Kim[1,2], Gyu-Nam Kim[1,2], Jae-Min Jung[1,2] Jae-Hyung Park[1,2] Jae-Uk Song[1,2] Nelly Aimelyne Mpuhwe[1,2] Young-Hag Koh[1,2,*]

[1]Department of Biomedical Engineering, Korea University, Seoul, Korea
[2]Interdisciplinary Program in Precision Public Health, Korea University, Seoul, Korea.

[*]E-mail: kjs061806@korea.ac.kr

Digital Light Processing (DLP) technology enables precise 3D printing, driving innovations across various industries, particularly in biomedical applications where high-performance materials such as dental composites are essential for patient safety and treatment efficacy. These composites must exhibit high mechanical strength and antibacterial properties to prevent bacterial infections and other complications when applied to the human body. Recent studies highlight the significance of developing antimicrobial materials in enhancing the performance of medical devices and prosthetics. Nanoparticles of metal oxides, especially cerium dioxide (CeO2), demonstrate remarkable antibacterial effects by generating reactive oxygen species (ROS) that induce oxidative stress in microbial cell walls and membranes. However, optimizing the concentration, size, and morphology of CeO2 nanoparticles for DLP 3D printing is crucial, as particle size significantly impacts structural and physical properties. This study aims to synthesize CeO2 nanoparticles using ultrasonic treatment and wet processes to control particle size and aggregation, ultimately developing optimal composite resins. The resulting composites are consistently producible via DLP 3D printing, promising contributions to applications requiring high mechanical strength and excellent antibacterial properties in the biomedical field. The research seeks to enhance the quality of biomedical materials through the development of antibacterial functional resin composites, increasing their applicability in medical settings.

Acknowledgement : This work was supported by the BK21 FOUR (BrainKorea21 Fostering Outstanding Universities for Research) funded by the Ministry of education and National Research Foundation of Korea (NRF)

References

[1] Laishram et al., Applied Surface Science, 536, 147731 (2021).
[2] He et al., Materials Science and Engineering C, 82, 233 (2018).

Keywords: DLP 3D printing, CeO_2 nanoparticles, antibacterial resin, ROS, dental materials

Enhancing radiotherapy efficacy for pancreatic cancer treatment through gold nanoparticle-based drug delivery system

Seonmin Choi[1,2], Yoonho Hwang[1], Hyeyoun Cho[1] and Jaehong Key[1]*

[1]Department of Biomedical Engineering, Yonsei University, Korea
[2]R&D centre, RayMed., Co., Ltd, Oseong 10408, Korea

*E-mail: jkey@yonsei.ac.kr

Among the various treatment options for cancer, radiotherapy has been a critical modality. Since the discovery of cytotoxicity caused by radiation, therapies using both external and internal radiation have been studied and have provided tremendous benefits in extending the lives of cancer patients. Despite significant advancements in radiation techniques, a persistent challenge in radiotherapy remains: optimizing the delivery of the maximum therapeutic dose to the tumor while minimizing exposure to surrounding critical organs. Over the past decades, nanomedicine has emerged as a key player in cancer diagnosis and therapy. Nanoparticles have the potential to significantly improve the efficacy of radiotherapy through various mechanisms. By delivering radionuclides or radiosensitizers into tumors, nanoparticles enhance the therapeutic effect of radiation while reducing its toxicity to non-target organs [1,2].

In this study, we propose cancer treatment approach using Auger electron radiation using gold nanoparticles and 99m-Tc, a diagnostic radioisotope. By optimizing the labeling of radioisotopes on the surface of gold nanoparticles and evaluating the therapeutic effects on pancreatic cancer cells, we confirmed that cell survival rates differed significantly depending on the presence or absence of synergistic effects between 99m-Tc and gold nanoparticles. This research suggests a new direction for enhancing the therapeutic efficacy of diagnostic radioisotopes.

Acknowledgement :

This work was supported by National Research Foundation of Korea (NRF) grants funded by the Korean government (grant nos. 2022RIS-005, 2022R1F1A1069516, 2021RIS-001) and Korea Institute of Science and Technology intramural research grant (2Z07014).

References (Maximum 2 References)

[1] Zhao, J., Zhou, M., & Li, C. (2016). Synthetic nanoparticles for delivery of radioisotopes and radiosensitizers in cancer therapy. *Cancer nanotechnology*, *7*, 1-23.

[2] Eetezadi, S., Ekdawi, S. N., & Allen, C. (2015). The challenges facing block copolymer micelles for cancer therapy: in vivo barriers and clinical translation. *Advanced drug delivery reviews*, *91*, 7-22..

Keywords: Drug Delivery System, Gold nanoparticle, Radiopharmaceuticals

Production of recombinant PETase by *Escherichia coli* and Optimization of PET biodegradation conditions

Jang-Sub Lee[1], Yeon-Jin Hong[1], Jin-Seob Shin[1], Hyung-Seok Lee[1], Byeong-Hee Kim[1], Suk-Jin Ha[1,*]

[1]Department of Biohealth-machinery convergence engineering, Kangwon National University, Chuncheon 24341, Republic of Korea

*E-mail: sjha@kangwon.ac.kr

Polyethylene terephthalate (PET) can be degraded by an enzyme called PETase, which is originated from Ideonella sakaiensis. A recombinant Escherichia coli BL21 (DE3) strain was genetically engineered to produce recombinant PETase. The optimal conditions for recombinant PETase overexpression were determined as follows: 20°C, 0.05 mM IPTG, induction O.D 0.5, and 200 rpm. Additionally, the reaction conditions of recombinant PETase were optimized to accelerate the degradation rate of PET. The amount of terephthalic acid released during PET degradation was quantified by HPLC analysis, depending on various recombinant PETase concentration. Subsequently, mutant recombinant PETase enzymes with altered amino acid sequences were generated using an error-prone PCR method to improve the activity of recombinant PETase. The mutants recombinant PETase enzyme were selected by comparing the diameter of the clear zone produced by bis-2-hydroxyethyl terephthalate digestion. The amino acid sequences of these mutants were compared with the wild type PETase.

Acknowledgement : This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No. 2022R1A4A1019201).

References

Keywords: PETase, microplastic, PET degradation, optimization

Title : Enhanced Interconnected Porous Microspheres via Photocuring-Assisted Emulsion of Ceramic Suspensions Using camphene and camphor as Dual Pore-Forming Agent

Jae-Hyung Park[1,2], Jae-Min Jung[1,2], Gyu-Nam Kim[1,2], Jae-Uk Song[1,2], Jun-Sik Kim[1,2], Nelly Aimelyne Mphuwe[1,2], Young-Hag Koh[1,2]*
[1]*School of Biomedical Engineering, Korea University, Seoul, 02841, South Korea*
[2]*Interdisciplinary Program in Precision Public Health, Korea university*

jhbest210@naver.com

Keywords: Emulsion, Freezing vehicle, Photopolymerization, Porous ceramics, Microsphere

Camphene is a widely used pore-forming agent for porous ceramics, as its solidified crystals can be easily sublimated, creating pores within the ceramic matrix. However, existing methods utilizing only camphene crystals to synthesize microspheres often result in fragile structures that lack sufficient interconnected pore networks. To overcome these limitations, we investigated the use of a camphene-camphor alloy as a combined pore-forming agent. The incorporation of camphor increased the solidification temperature of the ceramic slurry compared to that containing only camphene. When frozen at the same temperature, this modification led to an accelerated solidification rate, promoting the development of a highly interconnected structure. Additionally, the presence of camphor enhanced the rigidity of the microspheres post-freeze-drying, thereby improving their ability to retain a spherical shape.
The porosity and pore size of the microspheres were controlled through various parameters, including the content of pore-forming agents, the ratio of camphene to camphor, and the freezing temperature. Characterization of the green bodies was performed using field emission scanning electron microscopy (FE-SEM), revealing numerous elongated pores indicative of dendritic growth from the camphene-camphor alloy during freezing. After freeze-drying, the green bodies underwent heat treatment for debinding to carefully remove the photopolymerized monomer and other organic additives, followed by sintering to achieve high densification. The resulting microspheres exhibited no sharp edges, minimizing the risk of inflammation, and displayed a significantly enhanced interconnected pore channel structure. These porous microspheres demonstrate considerable promise for applications in the biomedical field, particularly in drug delivery systems and bone fillers.

Acknowledgement: This research was supported by the BK21 FOUR (BrainKorea21 Fostering Outstanding Universities for Research) funded by the Ministry of education and National Research Foundation of Korea (NRF).

References:
[1] J. B. Lee, W. Y. Mang, Y. H. Koh, H. E. kim, J. Eur. Ceram. Soc. 45 (2019) 21321.
[2] W. Y. Mang, J. W. Jeon, J. B. Lee, H. Lee, Y. H. Koh, H. E. Kim, J. Eur. Ceram. Soc. 40 (2020) 3469

Development of 3D printed antimicrobial CeO_2 loaded GelMa/PEGDA hydrogel with wound healing properties

Mpuhwe Nelly Aimelyne, Gyu-Nam Kim, Jae-Uk Song, Jun-Sik Kim, Jae-Min Jung, Jae-Hyung Park, Young Hag Koh*

School of Biomedical Engineering, Korea University, Seoul, Korea

Interdisciplinary Program in Precision Public Health, Korea University, Seoul, Korea

Email: kohyh@korea.ac.kr

Various wound healing dressings have been developed for example using liquid hydrogel, patches however fighting antibacterial action and speeding up the wound healing process still needs improvement. 3D Digital Light Processing (DLP) printing presents a solution of printing custom wound dressing with high resolution. In this study, GelMa-PEGDA hydrogel patch is fabricated by this 3D printing process and Cerium oxide is loaded into the hydrogel to add antibacterial properties. GelMa originates from the natural polymer Gelatin Methacryloyl and PEGDA (Polyethylene glycol diacrylate) on the other hand is a photocurable monomer which contributes to the mechanical properties of this hydrogel. Cerium Oxide (CeO_2) has variable oxidation states hence it can inter-change between $Ce3^+$ and $Ce4^+$ which gives it anti-oxidant properties. This is a solution to reducing the oxidation stress of the wound hence antibacterial action. In this study cerium oxide nanoparticles with spherical morphology are fabricated by the precipitation method. GelMa can imitate the extracellular matrix in factors like tunable mechanical properties and ability to have high water content due to its porous structure. In addition, Allura Red AC inert dye is used in this hydrogel composition in order to achieve a small curing depth suitable for DLP printing to obtain high resolution. The mechanical and biological properties of the hydrogel including the chemical properties of the nano-ceria particles are evaluated in this study.

Acknowledgement: These are results of a study on the "Leaders in INdustry-university Cooperation 3.0" Project, supported by the Ministry or Education and National Research Foundation of Korea and BK21 FOUR (BrainKorea21 Fostering Outstanding Universities for Research) funded by the Ministry of education and National Research Foundation of Korea (NRF)

References

[1] Wagh, M. P., et al. (2013). Effect of annealing temperature on the microstructural, optical, and electrical properties of CeO2 nanoparticles by chemical precipitation method. *Journal of Materials Science: Materials in Electronics, 24*(12), 5064–5071

[2] Vasincu, I. M., et al. "A Review of Chitosan's Properties as a Material for Tissue Engineering." *Journal of Functional Biomaterials*, vol. 13, no. 1, 2022, pp. 1-21.

Keywords: wound-healing, hydrogel, cerium oxide, 3D printing, GelMa

Synthesis and characterization of a chitosan-graphene composite for flexible strain sensors in biomedical health monitoring

Doljinsuren Enkhbayar[1] , Ahmed Ali[1,2] , Riaz Muhammad[1], Ezekiel Edward Nettey-Oppong[1], Young-Seek Seok[3], Seong-Wan Kim[4], and Seung Ho Choi[1,5*]

[1]Department of Biomedical Engineering, Yonsei University, Wonju 26493, Republic of Korea
[2]Department of Electrical Engineering, Sukkur IBA University, Sukkur 65200, Pakistan
[3]Gangwon-do Agricultural Product Registered Seed Station, Chuncheon 24410
[4]Department of Agricultural Biology, National Institute of Agricultural Sciences, Rural Development Administration, Wanju, Jeollabuk-do 55365, Republic of Korea
[5] Department of Integrative Medicine, Major in Digital Healthcare, Yonsei University College of Medicine, Seoul 06229, Republic of Korea

[*]E-mail: seunghochoi@yonsei.ac.kr

Wearable strain sensors, capitalizing on their ability to monitor minute and significant human biomechanical movements, are pivotal in health monitoring systems. This study introduces an innovative, stretchable, and biocompatible strain sensor developed from chitosan (CS) derived from biowaste and reduced graphene oxide (rGO), demonstrating a seamless merger of sustainability and performance. We fabricated and analyzed four sensors with varying CS to rGO ratios, among which CS/rGO-2 displayed superior mechanical and sensing capabilities, achieving a gauge factor of 10.7 across an impressive strain detection range of up to 125%. The optimized sensor demonstrated remarkable linearity (R^2=0.996), sustained stability for over 1600 cycles, and a consistent response throughout the entire strain spectrum. Our investigation further highlighted the sensor's robust mechanical properties, evidenced by a tensile strength of 110 ± 0.01 MPa. Functional tests across a spectrum of human movements from subtle facial skin deformation and mid-level limb stretching to significant joint movement attested to the sensor's versatility and high fidelity in capturing a broad array of biomechanical activities. The CS/rGO-2 sensor’s adeptness at registering pulse and heart rates, as well as its distinctive ability to discern individual phonetics through throat movement detection, positions it as a frontrunner for integration into advanced healthcare monitoring systems. Furthermore, its sustainable production methodology and the potential for degradation post-use underscore its environmental advantages. The convergence of biocompatibility, wide-ranging sensitivity, and ecological consciousness in the CS/rGO sensor design heralds a new era of eco-friendly wearable electronics in health monitoring technologies.

Acknowledgement: This work was supported by the National Research Foundation of Korea (NRF), grant-funded by the Korean government (MSIT) (No. 2022R1A2C1010151;2022R1C1C1011328; and the Brain Korea 21 Four Program. This research was also supported by the “Regional Innovation Strategy (RIS)” through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (MOE) in 2023 (2022RIS-005).

References

[1] Duan, L. et al. *Progress in Materials Science*, 114: p.100617 (2020).
[2] Park, J. et al. *Chemical Reviews*, 11, 460 (2024).
[3] Kim, G. et al. *Biosensors 11*, 347 (2021)

Keywords: strain sensor, wearable device, health monitoring, chitosan, reduced graphene oxide

Wrinkled PDMS-based Microfluidics Channel applied surface modification Droplet Generation

Jingwon Kim[1], Young Woo Gwak[1], Sugeun Lee[1], Danyou Lim[2], Sang Woo Lee[1,*], and Insu Park[2,*]

[1]Department of Biomedical Engineering, Yonsei University, Korea
[2]Department of Biomedical Engineering, Konyang University, Korea

[*]E-mail: insupark@konyang.ac.kr

The droplet generation technology in microfluidic channels has been used in diverse applications in the fields of chemistry and biological sciences. The benefits of droplet-based microfluidics include rapid reactions, high-throughput and the ability to analyze volume-limited samples. Surface characteristics are key factors in droplet formation. Previous methods often resulted in channels becoming hydrophilic during the bonding process, which limited their application unless a compound was used. The strategy is to modify the surface properties of channels to alter them to the desired characteristics. The surface becomes wetted by flowing the water and the WO droplet is deformed when the surface exhibits hydrophilic behavior. The droplet generation method is converted from jetting and wetting to dripping when the surface property exhibits hydrophobic. In our research, we closely observe droplet formation in both channels treated with chemical compounds and channels with surface modifications. We demonstrated that the wrinkle patterns effectively transform the surface properties from hydrophilic to hydrophobic, which is critical for controlling droplet formation. We use ImageJ software to quantitatively compare the differences in droplet formation between these two types of channels. Furthermore, we employ Finite Element Method (FEM) simulations to demonstrate how the corrugated structures change their properties. The purpose of this research is to provide quantitative data comparing droplet formation in chemically treated channels to wrinkled channels and to verify that wrinkle patterns can effectively alter surface properties through structural modifications to optimize droplet generation in microfluidic systems.

Acknowledgement : Please add acknowledgement if required.

References (Maximum 2 References)

[1] Lee, J. S., Hong, H., Park, S. J., Lee, S. J., & Kim, D. S., *Microelectronic Engineering*, *176, 101-105.* (2017).
[2] Li, Y., Dai, S., John, J., & Carter, K. R., *ACS applied materials & interfaces*, *5*(21), 11066-11073. (2013).

Keywords: Micro-droplet generation, PDMS-based Microfluidics, Nano-wrinkle patterns

Optimization of a multi-frequency SSVEP-Based BCI-Based Korean Speller with CHEONJIIN-style keyboard

Jiwon Ahn†, Min-A Jeon†, Giyeon Yu, Dohyun Yoo, Riaz Muhammad, Seung Ho Choi*

Department of Biomedical Engineering, Yonsei University, Wonju, Korea

*seunhochoi@yonsei.ac.kr

Abstract

Speller is a widely studied area of research using steady state visual evoked potential (SSVEP) and is an important way of allowing brain patients to communicate. Research has mainly been conducted in English since it is a globally recognized language, but it's hard for patients familiar with Korean to use. Therefore, we propose a Cheon-ji-in style keyboard that can communicate in Korean by controlling cursors through various flicker stimuli (7.5Hz, 9Hz, 10Hz, 11Hz, 12Hz). The electroencephalogram (EEG) signals obtained with 4 channels of OpenBCI (PO3, PO4, O1, O2) and reference signal (POz) were subjected to Fast Fourier Transform (FFT) and then feature extracted by Canonical correlation analysis (CCA) and received by computer. We demonstrate a mental spelling system, which is expected to be helpful for patients with motor abnormality.

Keywords: Brain-computer interface (BCI), Electroencephalogram (EEG), Steady state visual evoked potential (SSVEP), Canonical correlation analysis (CCA), CHEONJIIN keyboard layout

I. Introduction

A technology using electroencephalogram (EEG) to connect humans with external systems is called a Brain-Computer Interface (BCI). Steady state visual evoked potential (SSVEP), one of the methods used in BCI, occurs when the same frequency component as the stimulus appears in the occipital lobe, the visual center of the brain, when a user stares at a flicker of a particular frequency. It has been widely applied to BCIs for control, such as in spellers, wheelchairs, and robotic arms. For example, in 2022, Guo, Ning, et al. conducted A robotic glove for stroke patients using SSVEP to recycle hand function. [1]

Spellers are a extensively researched topic that allows users to type or select words. However, spellers have been developed mainly for English. Therefore, we propose a Cheon-ji-in style keyboard for Korean input. The Cheon-ji-in style keyboard is one of the Korean keyboard layouts, which is efficient for composing consonants and vowels. In addition, we adopted the Bremen speller format, which helps users type using a cursor, by employing five flickers with different frequencies. This allows users to track cursor movements in real-time.

II. Method

A. *Experimental design*

Eleven healthy subjects, seven men and four women, (aged 22 to 28 years) with normal or corrected-to-normal visual acuity were recruited for the study. For the duration of the experiment, EEG data was recorded at a sampling rate of 200Hz using OpenBCI Ganglion Board. We measured signals from all electrodes against a single reference electrode. According to 10-20 system, four electrodes (PO3, PO4, O1, O2) were placed in the parietal and occipital regions, with POz used as the reference to obtain data.

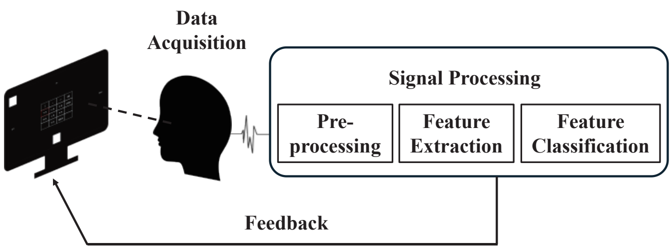


Figure 1. The process of experiment.

As shown in Figure 1, the subjects were instructed to look at the monitor from 70cm in front of the monitor. Participants could control the cursor to type what they wanted to write by staring at the stimulus.

B. *Stimulus presentation*

The visual stimulation was displayed on the LCD monitor. The screen had a resolution of 1920H×1080V pixels and a refresh rate of 60Hz. As illustrated in figure 2, 5 flickers blink on the monitor with different frequencies (7.5Hz, 9Hz, 10Hz, 11Hz, 12Hz), each in the shape of 150×150-pixel rectangle that alternates between white and black. [2]

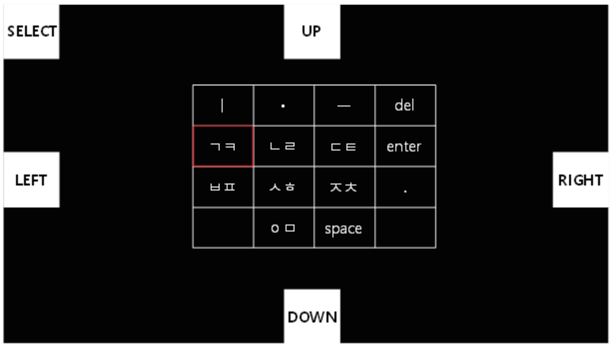


Figure 2. Design of monitor.

C. *Data analysis*

Recorded EEG signals were preprocessed by applying bandpass filter from 3Hz to 45Hz and notch filter at 50Hz and 60Hz. After filtering, we amplified data and used Fast Fourier Transform. To extract features from the signals, we adopted

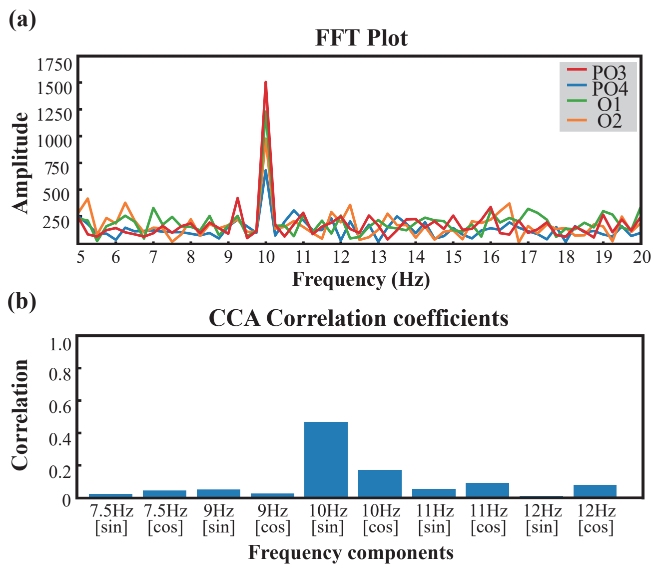


Figure 3. Data analysis (a) EEG signals from 10Hz signal with FFT (b) CCA correlation coefficients from 10Hz

canonical correlation analysis (CCA) to interpret results which flickers the participants were staring at, as shown in Fig.3. CCA is a method of calculating correlation between flicker signals and EEG signals. [3]

$$\rho = \frac{a^T \Sigma_{XY} b}{\sqrt{a^T \Sigma_{XX} a}\sqrt{b^T \Sigma_{YY} b}} \quad (1)$$

This equation represents correlation between two vectors a and b, converted to a linear combination of datasets X and Y.

III. Results

Through this experiment, we confirmed that SSVEP based Korean speller, Cheon-ji-in style keyboard, can combinate vowels and consonants using EEG signals. We will perform a test information transfer rate (ITR) to check how much information the system can effectively deliver per unit of time.

IV. Discussion

We strongly recommend enabling patients in real-world clinical settings to participate in experiments. It is necessary to develop an application or GUI that can be easily used by users. Also speed needs to be improved. This will be useful for patients who have difficulty with movement.

V. Acknowledgements

This work was carried out with the support of "Research Program for Agriculture Science & Technology Development (Project No. RS-2024-00399478)" Rural Development Administration, Republic of Korea. This work was supported by the National Research Foundation of Korea (NRF), grant funded by the Korean government (MSIT) (No. 2022R1C1C1011328).

VI. References

[1] Guo N, et al. SSVEP-based brain computer interface controlled soft robotic glove for post-stroke hand function rehabilitation. IEEE Trans Neural Syst Rehabil Eng. 2022; 30:1737-44.

[2] Jiang L, Pei W, Wang Y. A user-friendly SSVEP-based BCI using imperceptible phase-coded flickers at 60Hz. China Commun. 2022;19(2):1-14.

[3] Safi SMM, Pooyan M, Motie Nasrabadi A. Improving the performance of the SSVEP-based BCI system using optimized singular spectrum analysis (OSSA). Biomed Signal Process Control. 2018; 46:46-58.

Development of an auditory brainstem response measurement system for hearing impairment assessment based on deep learning

Sanghoon Nam*, Yeoeun Choi, Bomin Seo, Taemin Shin

Department of Biomedical Engineering, Yonsei University, wonju, Korea

*tjdrhd9387@naver.com

The number of people with disabilities is increasing every year due to the aging population. As we age, our behavior and physical functions gradually decline. In particular, hearing loss is difficult to avoid because we constantly hear sounds from birth. This makes it the second largest group of people with disabilities over the age of 65. The largest group is people with physical disabilities. And hearing tests are essential not only for the elderly but also for newborns. In the case of newborns, hearing is not just about the act of hearing itself, but also has a significant impact on language and cognitive development. Therefore, it is very important to detect hearing loss early and treat it through auditory rehabilitation. Auditory brainstem response tests are used as a method of diagnosing hearing impairment. However, this method measures EEG responses to sound, and is conducted based on the subjective judgment of a doctor by looking at the brainwave graph. Therefore, this study developed a system that can more accurately measure auditory brainstem tests by considering the newborn hearing tests currently conducted weekly and the increasing number of hearing impaired people every year. Sound stimulation can be Chirp and Click signals, and all device controls are done through a PC. There are fewer location restrictions as data is sent and received via AP.

References (Maximum 2 References)

[1] KRISTENSEN, Sinnet GB; ELBERLING, Claus. Auditory brainstem responses to level-specific chirps in normal-hearing adults. Journal of the American Academy of Audiology, 2012, 23.09: 712-721.

[2] Dau, Torsten, et al. "Auditory brainstem responses with optimized chirp signals compensating basilar-membrane dispersion." The Journal of the Acoustical Society of America 107.3 (2000): 1530-1540.

Keywords: ABR, EEG, AI, Signal Processing, Filter

Development of an auxiliary tool for objective consciousness assessment in patients with brain disease

Yeoeun Choi, Sanghoon Nam, and Taemin Shin*

Yonsei University

*E-mail: dudms923@naver.com

The evaluation of the patient's consciousness is mainly done using the Glasgow Coma Scale (GCS). This method measures three items (eye opening response, verbal response, and motor response), and the medical staff subjectively judges them. Due to subjective judgment, the GCS evaluation score of the same patient may be different depending on the medical staff, which may lead to medical accidents. Therefore, an auxiliary tool that can objectively judge the patient's consciousness is needed. In this study, we aim to develop a stimulation and measurement system that can objectively measure motor response among the GCS items. All systems are controlled using the QT Py ESP32-S2, a small MCU that can use wireless communication (WiFi). The stimulator measures the force applied to the patient by the medical staff using the MCU and load cell, and the measuring device measures the patient's movement using the EMG and acceleration sensors. The patient's movement is scored by comparing it to a set table. The data from the measuring device and the data from the stimulator can be monitored in real time and stored through the WPF interface. The stored data can be used to predict the prognosis of patients with brain diseases.

Acknowledgement :

References (Maximum 2 References)

[1] Han Young Jung. " Assessment of Patients with Minimally Conscious State: Recent Advances." Brain & NeuroRehabilitation 1.2 (2008): 129-135

[2] Teasdale, Graham, et al. "The Glasgow Coma Scale at 40 years: standing the test of time." The Lancet Neurology 13.8 (2014): 844-854.

Keywords: GCS, motor response, wifi, simulator, measurement

Design Techniques for Multi-Channel Instrumentation Amplifiers for Biomedical Applications

Junbeom Park[1], Jeong Hoan Park[2], Tao Tang[2], Lian Zhang[2], Kian Ann Ng[3], Hyoungjoon Kim[1], and Jerald Yoo[1*]

[1]Department of Electrical and Computer Engineering, Seoul National University, Seoul, Korea.
[2]Dept. of ECE, National University of Singapore
[3]N.1 Institute for Health, Singapore

E-mail: jerald@snu.ac.kr

The advancement of biomedical devices requires multi-channel readout circuits for improved signal acquisition from various sources, such as electrodes or sensors placed on different parts of the human body. A multi-channel instrumentation amplifier (IA) enhances spatial resolution, leading to more accurate diagnostics and data interpretation while offering scalability without requiring multiple discrete amplifiers. However, designing such IAs involves additional considerations in minimizing area-per-channel and between-channel mismatch in addition to meeting traditional IA requirements, including accurate gain, low noise, low power consumption, and offset mitigation. This paper reviews the design techniques for multi-channel IAs for biomedical applications: (1) “Channel-Sharing IA” optimizes power and area efficiency by sharing a single IA across multiple channels [1]. (2) “Orthogonal Frequency-Chopping IA” minimizes demodulation overhead by using Walsh-code as the chopping signal, shifting complexity to external devices [2]. Lastly, (3) “Intrinsic-Feedback Capacitor IA” reduces area dramatically in a capacitively-coupled IA by leveraging MOSFET gate-to-drain overlap capacitance as a replacement for traditional feedback capacitors.

Acknowledgment : This work was supported by the BK21 FOUR program of the Education and Research Program for Future ICT Pioneers, Seoul National University in 2024.

References

[1] M. Altaf *et al.*, “A 1.83 μJ/Classification, 8-Channel, Patient-Specific Epileptic Seizure Classification SoC Using a Non-Linear Support Vector Machine,” *IEEE Trans. Biomed. Circ. Sys. (TBioCAS)*, vol. 10, no. 1, pp. 49-60, Feb. 2016.
[2] J. Park *et al.*, “A 15-Ch. 0.019 mm2/Ch. 0.43% Gain Mismatch Orthogonal Code Chopping Instrumentation Amplifier SoC for Bio-Signal Acquisition *Proc. IEEE Asian Solid-State Circ. Conf. (A-SSCC)*, pp. 295-296, Nov. 2019.

Keywords: Instrumentation amplifier, offset cancellation, between-channel mismatch

Soft, Skin-Interfaced, Wireless Multi-Channel EMG Monitoring and Analyzing System for Rehabilitation Exercise Assistance

Sumin Kim[1, 2)], Seunghun Han[1, 2)], and Jahyun Koo[1, 2,*)]

1) School of Biomedical Engineering, College of Health Science, Korea University, Seoul 02841, Republic of Korea, 2) Interdisciplinary Program in Precision Public Health, Korea University, Seoul 02841, Republic of Korea

*E-mail: jahyunkoo@korea.ac.kr

Exercises for rehabilitation are essential for regaining motor function after injuries such as fractures, ligament damage, or nerve injury. However, it can be difficult to carry out these exercises correctly without expert guidance. Improper performance may not only slow the recovery process but could also lead to secondary injuries. To address this issue, surface electromyography (sEMG), which measures electrical signals generated by muscle contractions through the skin, provides a useful method to monitor muscle activation levels during rehabilitation.

In this research, we propose a wireless, multi-channel sEMG monitoring device designed to assist patients in performing rehabilitation exercises properly. The device utilizes a flexible printed circuit board (FPCB) to adapt to the skin's curve. This feature enhances the precision of muscle activation monitoring. Additionally, the device distinguishes between muscles that should be active and those that should remain inactive, while also tracking the sequence of muscle engagement to ensure alignment with the therapeutic objectives of each exercise.

By providing real-time feedback on muscle activation, this device helps patients perform prescribed exercises accurately, even in environments without professional guidance. Our goal is to enhance the effectiveness of rehabilitation, accelerating motor function recovery and reducing the risk of improper exercise execution. In addition to helping patients recover, this method guarantees that rehabilitation exercises may be carried out properly, which leads to quicker and safer recovery results.

Acknowledgement : This research was supported by the BK21 FOUR (Fostering Outstanding Universities for Research) and Leaders in INdustry-university Cooperation 3.0 Project funded by the Ministry of Education (MOE) of Korea and National Research Foundation (NRF) of Korea.

References

Keywords: Wireless, Surface Electromyography, Rehabilitation Exercise

High-throughput screening system for immunogenic cell death inducers based on AI real-time image analysis

Eunseo Kim[1*], Minji Kim[1*], Donghoon Jang[2*], Jiwon Heo[3*], Minji Choi[1], Jisoo Shin[1], Youngbin Seo[1], Daeun Lee[1], Jaehyeon Yoo[1], Hyungyu Lee[5#], Jong-Ho Cha[1,4#]

Department of Biomedical Science, Program in Biomedical Science and Engineering, Inha University[1]

[1]Department of Biomedical Science, Program in Biomedical Science and Engineering, Graduate school, Inha University

[2]Department of Electrical and Computer Engineering, Inha University

[3]Department of Computer Science, Inha University

[4]Department of Biomedical Science, [5]Department of Medical Education and Medical Humanities, College of Medicine, Inha University

Cancer immunotherapy has attracted attention for its high therapeutic efficacy and low side effects, but its effectiveness is reduced in most solid tumors, which are typically characterized as cold tumors with low immunogenicity. To address these limitations, recent research has focused on converting cold tumors into hot tumors by inducing immunogenic cell death (ICD).

Identifying ICD-inducers selectively requires considerable time and effort, as it necessitates a comprehensive assessment of changes in cell morphology and spatiotemporal variations in various metrics. In this study, we developed an AI algorithm that can recognize the morphological characteristics of lytic cell death and integrated it into a high-throughput screening (HTS) system.

The AI-based ICD prediction algorithm successfully identified ICD inducers among 8 substances in a blind test. To validate the AI-predicted candidates, the system first excluded apoptosis-inducing substances and then evaluated DAMP release and antigen-presenting cell activation. As a result, the system demonstrated its ability to quickly and accurately identify ICD candidates based on optical images alone.

Transfer Learning-Based Approaches for Predicting Parkinson's Disease Using REM EEG Signals

Somin Oh[1], Hyeyoun Cho[1], Rumana Ferdushi[1], Yoonho Hwang[1], Erdenebayar Urtnasan[2],and Jaehong Key[1*]

[1]Department of Biomedical Engineering, Yonsei University, Korea
[2]Institute of AI Data Convergence Science, Yonsei University Mirae Campus, Korea

[*]E-mail: jkey@yonsei.ac.kr

Parkinson's disease (PD) is the second most common neurodegenerative disease which usually presented in 50s. There is no cure or single biomarker for the disease, so the importance of early detection is increasing[1]. In this study, we proposed transfer learning-based approaches for predicting Parkinson's Disease using sleep Electroencephalography(EEG) signals across Sleep Stages, consisting of REM. The base model of proposed approaches utilizes VGG, Resnet, and Efficient Net. After the base models, Global Average Pooling was applied to standardize feature map sizes. The results were processed with Dense layers of 512 and 128 units, followed by a final Dense layer with sigmoid activation for Parkinson's disease diagnosis. The dataset consists of 13 participants taking medication for treatment and 52 control participants, from the Sleep Heart Health Study. Signal dataset is composed of REM stage, with training set of 7,598 and test set of 1,900 episodes. REM sleep EEG signals were sampled at 125Hz and segmented. STFT was applied with a 125s window and 60s overlap to convert to the frequency domain. A 3-channel input was created by averaging two EEG signals, yielding a final size of 64 x 64 x 3. We obtained 83-85% accuracy, with the highest accuracy achieved by the transfer learning model using ResNet50 at 85.11%. This can demonstrate an AI model based on sleep stages and the effectiveness of utilizing transfer learning.

Acknowledgement : This work was supported by National Research Foundation of Korea (NRF) grants funded by the Korean government (grant nos. 2022RIS-005, 2022R1F1A1069516) and Korea Institute of Science and Technology intramural research grant (2Z07014).

References

[1] Shaban, Mohamed. "Deep learning for Parkinson's disease diagnosis: a short survey." Computers 12.3 (2023): 58.

Keywords: Parkinson's Disease, Electroencephalography, Transfer learning

Development of a Deep Learning Algorithm for Major Depressive Disorder Diagnosis Based on Lifelog Data

Jaehoon Ko[1], Hyeyoun Cho[1], Rumana Ferdushi[1], Yoonho Hwang[1], Erdenbayar Urtnasan[2,3], Jaehong Key[1*]

[1]Department of Biomedical Engineering, College of Sotfware Digital Health Convergence, Yonsei University, Korea
[2]Institute of Yonsei AI Data Convergence Science, Yonsei University, Korea
[3]Artificial Intelligence Big Data Medical Center, Wonju College of Medicine, Yonsei University, Korea

[*]jkey@yonsei.ac.kr

In this study, we developed an AI-based algorithm to predict Major Depressive Disorder (MDD) in the elderly population using smartband data. Over a three-year, community-based cohort study, we monitored MDD in elderly individuals by collecting lifelogging data such as daily activity, step count, sleep patterns, and heart rate via Galaxy II smartwatches. After cleansing and preprocessing the data, we extracted 15 key features related to sleep, steps, and heart rate. Random Forest and XG Boost ensemble models were employed to identify the most significant features contributing to the prediction of MDD. For model development, we implemented a Multi-Layer Perceptron (MLP) and a 1D Convolutional Neural Network (1D-CNN), training both models over 100 epochs. The model's performance was evaluated using a confusion matrix, and metrics including accuracy, precision, recall, and F1-score were calculated. The final model achieved an accuracy of approximately 80% in predicting depression using smartwatch data. These results highlight the potential of wearable devices in monitoring mental health, demonstrating how daily activity data can be effectively used to predict depression in elderly populations. Wearable technology, combined with advanced machine learning techniques, offers promising tools for early detection and intervention in mental health care.

Acknowledgement : This work was supported by National Research Foundation of Korea (NRF) grants funded by the Korean government (grant nos. 2022RIS-005, 2022R1F1A1069516) and Korea Institute of Science and Technology intramural research grant (2Z07014).

References (Maximum 2 References)

[1] He, L., Chan, J. C. W., & Wang, Z. “Automatic depression recognition using CNN with attention mechanism from videos”. *Neurocomputing*, *422*, 165-175, 2021

Keywords: Major Depressive Disorder (MDD), Ensemble Learning, MLP, 1D-CNN,

Generalized ECG Feature Learning and Arrhythmia Classification Using Contrastive Predictive Coding

Hyeonjung Kim[1†], Youngshin Kang[1] , Geunbo Yang[1], Jong Seon Lee[2] and Cheolsoo Park[1*]

[1]Department of Computer Engineering, Kwangwoon University,Seoul, KR 01897, Republic of Korea
[2]Holmes AI, Daegu, KR 41260, Republic of Korea

[*]E-mail: a9016038@gmail.com;
ysin0414@gmail.com;
rmsqhwkd2@gmail.com;
jongseon@holmesai.co.kr;
parkcheolsoo@kw.ac.kr;

Electrocardiogram (ECG) data, widely used to diagnose cardiovascular conditions like arrhythmias, is a time-series recording of the heart's electrical activity[1]. Since arrhythmia is unpredictable and may only manifest briefly, real-time ECG analysis is crucial for monitoring and detecting emergencies. However, obtaining labeled ECG data requires annotation by medical professionals, which is time-consuming and costly.To address these challenges, recent studies have explored unsupervised and self-supervised learning approaches that do not require labeled data. Among these, Contrastive Predictive Coding (CPC) predicts future sequences without relying on specific peaks or segments, enabling the generation of useful feature vectors and generalized representations[2]. This reduces the dependency on domain-specific feature extraction and improves classification and prediction tasks.In this study, we combined a pretrained CPC encoder with a CNN-based classifier to classify arrhythmias in ECG data. The model achieved accuracies of 0.94, 0.86, 0.75, and 0.83 for Normal (N), Atrial premature (A), Supraventricular premature (S), and Premature ventricular contraction (V), respectively. Corresponding precision values were 0.90, 0.90, 0.73, and 0.85. These results demonstrate that CPC-based latent representation learning can effectively address the lack of labeled data and feature extraction challenges, with strong potential for broader time-series data applications.

Acknowledgement : This work was supported by the National Research Foundation of Korea(NRF) grant funded by the Korea government(MSIT) (No.RS-2023-00244176).

References

[1] Luz, Eduardo José da S., et al. "ECG-based heartbeat classification for arrhythmia detection: A survey." *Computer methods and programs in biomedicine* 127 (2016): 144-164.
[2] Tsipouras, Markos G., Dimitrios I. Fotiadis, and D. Sideris. "An arrhythmia classification system based on the RR-interval signal." *Artificial intelligence in medicine* 33.3 (2005): 237-250.

Keywords: Electrocardiogram, Arrhythmia, contrastive Predictive Coding

Pancreatic Cancer Segmentation Using a Hybrid CNN-Transformer Model on CT Scan Images

Nirmal Adhikari[1], Tursunbaev Chingiz[2], SeungKyu Oh[3], Toshboev Bobomurot[4], and Wookey Lee[5*]

[1,2,4,5]Biomedical Science and Engineering Department, Inha University, Korea
[3]Industrial Engineering Department, Inha University, Korea.

*E-mail: adhikareen@inha.edu[1]
Chingiz2503@inha.edu[2]
december_i@inha.edu[3]
toshboyevbobosh@gmail.com[4]
trinity@inha.edu[5]

Pancreatic cancer poses significant challenges in clinical diagnosis due to its often late-stage detection and complex tumor structures, making accurate delineation of cancerous regions critical for effective treatment. This project aims to develop a hybrid model combining convolutional neural networks (CNNs) and Transformer-based architectures to improve the precision of segmenting cancerous regions from CT scan images. The model is based on a U-Net architecture, with a CNN-based encoder that extracts multi-scale hierarchical features, followed by Swin Transformer layers that capture long-range dependencies and global context. The decoder reconstructs high-resolution segmentation maps, precisely outlining cancerous regions. By leveraging both local feature extraction and global contextual understanding, this hybrid model processes 2D CT slices to generate accurate segmentation masks, evaluated against ground truth annotations. The integration of Transformer-based architectures allows the model to account for spatial relationships and fine-grained details essential for detecting irregular tumor boundaries. Additionally, advanced data augmentation techniques enhance the model's robustness and generalization to new cases. This approach aims to assist radiologists by improving segmentation accuracy, streamlining diagnostic workflows, and contributing to better clinical outcomes in pancreatic cancer management.

References

[1] Ze Liu, et al., *Swin Transformer: Hierarchical Vision Transformer using Shifted Windows*, ICCV (2021).

Keywords: Pancreatic Cancer Segmentation, Swin Transformer, Cancer Detection, CT Scan

Comparison of Decision Tree Classification Algorithms on EEG Data

Nayeon Lee and Jongmo Seo* (12 points)

Department of Electrical and Computer Engineering, Seoul National University, Seoul, Korea

*E-mail: yons24@snu.ac.kr

The electroencephalogram (EEG) is often used to diagnose and analyze epileptic seizures. As seizures are preceded by changes in EEG and seizure prediction from EEG data is a promising field of research. Machine learning is a popular tool in this area, and various algorithms from the classic support vector machine (SVM) to recent deep learning models are being tested. However, the comparison of models applied to different datasets is imperfect as the datasets themselves can act as a variable. In this paper we compared the precision of different machine learning algorithms on a single open dataset.

Acknowledgement : This work was supported by the Institute of Information & Communications Technology Planning & Evaluation(IITP)-Global Data-X Leader HRD program grant funded by the Korea government(MSIT)(IITP-2024-00441407). This research was supported by a grant of 'Korea Government Grant Program for Education and Research in Medical AI' through the Korea Health Industry Development Institute(KHIDI), funded by the Korea government(MOE, MOHW). This study utilized the Epileptic EEG Dataset created by Wassim Nasreddine, published on March 16, 2021, made available through the Mendeley Data (DOI: 10.17632/5pc2j46cbc.1), and made possible by NPRP grant # NPRP12S-0305-190231 from the Qatar National Research Fund (a member of Qatar Foundation). The findings achieved herein are solely the responsibility of the authors.

References (Maximum 2 References)

[1] Rasheed, Khansa et al. *IEEE reviews in biomedical engineering*, 14, 139-155 (2021)

Keywords: EEG, Machine learning, Random forest, Extra trees

Predicting Heart Disease Risk Using Demographic, Lifestyle, Socioeconomic, and Psychological Factors: A Machine Learning Approach

Toshboev Bobomurot[1], Nirmal Adhikari[1], Tursunbaev Chingiz[1], Abdusattorov Umid[3], Kim Gwangsoo[2], Wookey Lee[1,2]

[1]Department of Biomedical Science and Engineering, INHA University, Incheon, Korea
[2]Department of Industrial Engineering, INHA University, Incheon, Korea
[3]Department of Rehabilitation, Multidisciplinary clinic of Tashkent Medical Academy, Tashkent, Uzbekistan

E-mail: toshboyevbobosh@inha.edu, adhikareen@inha.edu, chingiz2503@inha.edu, umid_medlife@inbox.ru, 22241248@inha.edu, trinity@inha.ac.kr

Abstract

In contemporary society, the emphasis on maintaining a "healthy lifestyle" and "wholesome living" has grown substantially as an increasing number of individuals recognize the importance of a balanced way of life. Concurrently, the medical field has witnessed significant advancements, particularly with the integration of artificial intelligence (AI) and automation, reshaping diagnostic practices by providing faster and more accurate assessments. Through their ability to process vast amounts of patient data, AI systems have become invaluable tools in assisting healthcare professionals in making more informed and timely decisions. This study introduces an innovative approach for predicting heart disease risk, leveraging a novel dataset that incorporates demographic, lifestyle, socioeconomic, and psychological factors.

To address the complex challenge of heart disease prediction, we propose a Convolutional Neural Network (CNN)-based deep learning (DL) model designed to improve prediction accuracy by accounting for many variables contributing to heart disease. Heart disease is a multifactorial condition influenced by lifestyle choices, genetic predispositions, and environmental factors, making its accurate prediction inherently tricky. While genetic factors play a critical role, lifestyle-related influences, such as diet, exercise, and stress, are also pivotal in the onset and progression of the disease. The application of AI and machine learning (ML) in healthcare has grown significantly in recent years, with models increasingly being employed to predict disease outcomes. Traditional ML models, such as Decision Trees, Random Forests, and K-nearest neighbors (KNN), have shown promising results when applied to widely used datasets like the UCI Heart Disease dataset, which consists of 13 key attributes. However, these models often exhibit diminished performance when applied to new or evolving datasets, underscoring the need

for more robust DL techniques, particularly CNNs, which have demonstrated substantial potential in such predictive tasks.

Our proposed CNN model dynamically assigns importance to different features during training, enabling it to refine its predictions with each iteration. By integrating a comprehensive range of features—including demographic, lifestyle, socioeconomic, and psychological factors—we aim to achieve higher prediction accuracy and provide a more holistic assessment of heart disease risk. For this study, we utilized a dataset from the Multidisciplinary Clinic of Tashkent Medical Academy, extending beyond traditional medical indicators by incorporating the patient's lifestyle, psychological well-being, and genetic background. This comprehensive approach enhances the reliability of the model's predictions, offering a more personalized risk assessment for heart disease.

The proposed CNN model achieved an impressive accuracy of 96% on the collected dataset, marking a significant improvement over existing models. By incorporating a more comprehensive array of factors—including demographic, lifestyle, socioeconomic, psychological, and genetic variables—our model offers a more robust and reliable framework for assessing heart disease risk. This high accuracy underscores the potential of our model to contribute to the ongoing advancements in AI-driven healthcare.

Keywords: Heart disease prediction, deep learning, demographic factors, lifestyle, psychological factors

References

[1] Md Maruf Hossain, Md Shahin Ali, Informatics in Medicine Unlocked, “Cardiovascular disease identification using a hybrid CNN-LSTM model with explainable AI", 15, 2023.

[2] Li Z., Liu F., Yang W., Peng S., Zhou J. A survey of convolutional neural networks: analysis, applications, and prospects // IEEE transactions on neural networks and learning systems. 2021. T. 33. № 12. C. 6999-7019

IP-033

Hybrid Neural Network Model for Anomaly Detection in Implantable Devices Using Graph Attention Networks and Transformers

Dongwook Kwon[1], Minji Kim[1], Youngshin Kang[1], Jihong Lee[1], and Cheolsoo Park[1,*]

[1]Department of Computer Engineering, Kwangwoon University, Seoul, Korea.

[*]E-mail: parkcheolsoo@kw.ac.kr

Implantable devices, which are integral components of cyber-physical systems[1], face significant vulnerabilities to faults and malfunctions, necessitating the implementation of robust monitoring and advanced anomaly detection technologies. Traditional approaches to anomaly detection often rely on forecasting models that flag anomalies by comparing predicted values with observed data, but these methods frequently neglect the intricate relationships between various system components. This paper proposes a novel hybrid neural network model that integrates graph attention networks[2], gated recurrent units, and transformer encoders to overcome this limitation. Our architecture captures temporal dependencies and structural relationships in the data, improving anomaly detection performance. By utilizing attention mechanisms, the model not only improves detection accuracy but also provides valuable insights into the interactions among system components, which in turn facilitates more effective fault diagnosis. The experimental results validate the effectiveness of our approach, demonstrating that the bidirectional gated recurrent units graph attention network transformer model significantly outperforms conventional methods, with a remarkable specificity of 0.997 and a times-aware precision score of 0.985, alongside a balanced F1 score of 0.906. These results highlight the model's suitability for real-world anomaly detection in cyber-physical systems.

Acknowledgement : This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government(MSIT) (No. RS-2022-00165231). Additionally, this work was supported by Institute of Information & communications Technology Planning & Evaluation (IITP) grant funded by the Korea government(MSIT) (No.RS-2023-00229800, Development of quantitative emotion-sensibility evaluation model of non-face-to-face environment users and commercialization of interactive digital contents application).

References

[1] Li, D., et al. International Conference on Artificial Neural Networks, Cham: Springer International Publishing, 402-416 (2019)
[2] Deng, A. and Hooi, B. AAAI Conference on Artificial Intelligence, 35, 4027–4035 (2021)

Keywords: Anomaly Detection, Transformer, Implantable Device, Deep Learning

Application of remote heart rate estimation on a treadmill using a mixture of expert-based time series transformer model

Yusang Nam[1], Junghwan Lee[1], Hyuentae Lee[1] and Cheolsoo Park[1*]

[1]Department of Computer Engineering, Kwangwoon University, Seoul, Korea

[*]E-mail: parkcheolsoo@kw.ac.kr

The remote-photoplethysmogram is the basis for remote heart rate estimation[1]. The changes in blood flow produced by the heartbeat and the resulting subtle changes in skin colour make it possible to estimate heart rate using a camera. However, due to the basic principle of rPPG described above, it is sensitive to noise caused by user movement. This can pose challenge when developing a service that remotely monitors heart rate, particularly in the fitness industry. Although there are various types of fitness activities, we concentrate on remote heart rate estimation during treadmill workouts, which are especially chanllening due to significant and vigorous movements. We selected TimeMoE[2] as the model for our experiments, which processes one-dimensional time series data as input. However, because our study involves multivariate time series data-including acceleration of face landmarks, rPPG-based algorithm OMIT output, CEEMDAN output, and STFT results for frequency domina features-a seperate embedding process is necessary. To address this, we trained and utilized the TS2Vec model.

Acknowledgement : This work was supported by the Commercializations Promotion Agency for R&D Outcomes (COMPA) grant funded by the Korea government(MSIT) (No. 1711179046) and This work was supported by Institute of Information & communications Technology Planning & Evaluation (IITP) grant funded by the Korea government(MSIT) (No.RS-2023-00229800, Development of quantitative emotion-sensibility evaluation model of non-face-to-face environment users and commercialization of interactive digital contents application)

References

[1] De Haan, Gerard and Vincent Jeanne. *IEEE transactions on biomedical engineering* 60.10 (2013)

[2] Shi, Xiaoming, et al. *arXiv*, 2409,16040(2024)

Keywords: remote-photoplethymogram, mixture of experts, heart rate, treadmill

Citric Acid Disassembles α-Synuclein Fibrils and Reduces Their Cytotoxicity

Yeon Ho Kim[1,2], Hyo Gi Jung[1,2], and Dae Sung Yoon[1,2*]

[1]Department of Biomedical Engineering, Korea University, Seoul, Korea
[2]Interdisciplinary Program in Precision Public Health, Korea University, Seoul, Korea.

[*]E-mail: dsyoon@korea.ac.kr

α-synuclein plays a crucial role in regulating neurotransmitter release and synaptic plasticity. However, the misfolding and aggregation of α-synuclein with neuronal toxicity are major hallmarks of Lewy bodies related to progressive neurodegenerative disorders, including Parkinson's disease, dementia with Lewy bodies, and multiple system atrophy. Therefore, the development of therapeutics targeting α-synuclein aggregates is crucial for treating synucleinopathies by removing neurotoxic agents and preventing further disease progression. Herein, we have identified that citric acid can disassemble α-synuclein fibrils and mitigate their neuronal toxicity. Our findings demonstrate that citric acid can effectively disrupt the β-sheet structure of α-synuclein fibrils and inhibit additional fibril formation. Molecular docking simulation further supports these results, revealing that citric acid exhibits a high affinity for the β-strand and the surrounding region within α-synuclein fibrils. We propose that citric acid, commonly found in food supplements, holds significant promise as a therapeutic for treating neurodegenerative diseases related to synucleinopathies.

Acknowledgement : This work was supported by a National Research Foundation of Korea (NRF) grant funded by the Korean Government (MSIP) (NRF-2022R1A2C1091756, and NRF-2022R1A6A3A13072828), BK21 FOUR Institute of Precision Public Health, Health Fellowship Foundation, and the Bio & Medical Technology Development Program of the National Research Foundation funded by the Korean government (No. 2023M3E5E3080743).

References

[1] Lee, D., Jung, H. et al. *ACS Applied Materials & Interfaces* **15**, 2 (2023)
[2] O.M. Abdel-Salam, E.R. Youness et al. *Asian Pacific Journal of Tropical Medicine* **9(12)** (2016)

Keywords: Parkinson's disease, α-synuclein, Citric acid, Synucleinopathy, Cytotoxicity, Fibril disassembly

Comparative Evaluation of Neural Network Architectures for Automated Sleep Stage Classification Using EEG and EMG Signals

Jinyoung Choi[1], Hankil Oh[2], Minkyu Ahn[2,*]

[1]Massachusetts General Hospital, Harvard Medical School, Boston, MA, United States
[2]School of Computer Science and Electrical Engineering, Handong Global University, Pohang, South Korea

[*]E-mail: jinyoung_choi@mgh.harvard.edu, hankil2401@gmail.com, minkyuahn@handong.edu

Sleep stage classification is a crucial yet challenging area in sleep research, often complicated by the time-consuming processing of large datasets. Neural networks are being used to automate this task, including in animal studies involving mice and rats. In this study, we compare the performance of three neural network models for sleep stage classification: a 1-dimensional convolutional neural network (1D-CNN), AccuSleep, and DeepSleepNet utilizing the same dataset from [1]. We also assess the impact of feature normalization techniques, such as mixture z-scoring[1]. Our results indicate that mixture z-scoring improves classification accuracy balance, particularly in models using engineered features like AccuSleep. In both within and cross-subject comparisons, AccuSleep demonstrated strong performance, with cross-subject results remaining consistent across all 10 mice. This consistency reflects the effectiveness of mixture z-scoring in reducing distributional shifts by adjusting sample distributions. However, while DeepSleepNet and 1D-CNN often exhibit higher overall performance when not considering mixture z-scoring, the latter technique had minimal impact on raw signal-processing models like 1D-CNN. Feature normalization proved particularly effective in the cross-subject approach, where mixture z-scoring helped shift the data distribution. These findings highlight the need to align preprocessing strategies with model architecture, ensuring compatibility of techniques.

Acknowledgement: This research was supported by the MSIT(Ministry of Science and ICT), Korea, under the National Program for Excellence in SW) supervised by the IITP(Institute of Information & Communications Technology Planning & Evaluation) in 2024 (2023-0-00055), and also by Sabbatical Leave Grant at Handong Global University(HGU-2023), the National Research Foundation of Korea (NRF) grant (No.2021R1I1A3060828).

References

[1] Barger, Z. et al. *PLOS ONE 14,* e0224642, (2019)

Keywords: Neural networks, Sleep stage classification, Normalization, Mixture z-scoring

The relationship between body mass index and brain volume

Yubin Oh[1], Junbeom Lee[1], Jonghun Lee[1], Dohyun Kim[1], Yechan Kim[1], Wonpil Jang[1], Wanhyung Lee[2], Joon Yul Choi[1*]

Department of Biomedical Engineering, Yonsei University[1]
Department of Preventive Medicine, College of Medicine, Chung-Ang University[2]

*E-mail: jychoi717@yonsei.ac.kr

Body mass index (BMI) is recognized as an important clinical indicator for health management and disease prevention. Recent neuroimaging research has highlighted the relevance of brain structural and functional alterations in relation to BMI [1-2]. This study aimed to investigate the relationship between BMI and whole brain volume excluding the ventricles in 111 individuals (ages 25-67 years, BMI 17.5-33.6) using MRI. T1-weighted images were processed through Freesurfer's 'recon-all' pipeline to obtain volumetric data. To assess differences between high BMI (BMI ≥ 25) and low BMI (BMI < 25) groups, a Student's t-test was performed. Additionally, a general linear model (GLM) was constructed to adjust for the potential confounding effects of age and gender on brain volume. The high BMI group (12135398 ± 121576 mm^3) has a significantly larger brain volume compared to the low BMI group (1167531 ± 99553 mm^3) ($p = 0.0041$). In the GLM, a significant association was found between whole brain volume and BMI groups ($p = 0.033$) with a positive β value (0.0016323). These findings suggest a complex relationship between BMI and brain structure and warrant further research to understand the underlying mechanisms.

References

[1] Li, Guanya, et al., Molecular psychiatry, 28, 1466-1479 (2023)
[2] Han, Yi-Peng, et al., Ageing Research Reviews, 71, 101445. (2021)

Keywords: Body mass index, Brain volume, Magnetic resonance imaging

Impact of Segmentation Improvement on White Blood Cell Counting Accuracy

Jihong Lee[1], Youngshin Kang[1], Minji Kim[1], Jihwan Won[1], Dongwook Kwon[1] and Cheolsoo Park[1,*]

[1]Department of Computer Engineering, Kwangwoon University, Seoul, Korea

[*]E-mail: parkcheolsoo@kw.ac.kr

Nailfold capillaroscopy is widely used to evaluate capillary's function, with white blood cell (WBC) counting playing a key role in assessing blood flow and diagnosing related diseases. This study tried to investigate whether the performance of the nailfold capillary segmentation could affect the precision of the white blood cell counting. We developed a segmentation pipeline based on [1], utilizing conventional image processing approaches. The segmentation process used 15 automated local thresholds, combined with the Simultaneous truth and performance level estimation (STAPLE) algorithm to create a probabilistic segmentation map. Post-processing steps were applied to further refine the results. Despite the significant improvement in the capillary segmentation, particularly in defining the extensive capillary areas, notable enhancement in the white blood cell counting accuracy was not achieved. These results suggest that the WBC counting needs additional processes as well as the segmentation procedure such as the increase of frame rate (FPS) or WBC visibility improvement through other preprocessing techniques, which will be looked into in the future study.

Acknowledgement : This work was supported by Institute of Information & communications Technology Planning & Evaluation (IITP) grant funded by the Korea government(MSIT) (No.RS-2023-00229800, Development of quantitative emotion-sensibility evaluation model of non-face-to-face environment users and commercialization of interactive digital contents application) , This work was supported by the National Research Foundation of Korea(NRF) grant funded by the Korea government(MSIT) (No.RS-2023-00244176). and This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government(MSIT) (No. RS-2022-00165231) and We obtained the Korean IRB approval (No. P01-201903-11-02) to conduct the experiments involving human participants.

References

[1] Isgrò, F. et al., In Proceedings of the 26th IEEE International Symposium on Computer-Based Medical Systems 26, 227-232 (2013).
[2] Kim, B. et al., Sensors 20, 7101 (2020).

Keywords: nailfold capillary, sementic segmentation, white blood cell counting, image registration

Tunable SHEL Based on ITO Metasurface for Chiral Molecules detection

Sangmin Shim[1] , Kyunghyun Yu and Dasol Lee[1]*

[1] Department of Biomedical Engineering Yonsei University, Wonju, Republic of Korea.

*E-mail: dasol@yonsei.ac.kr

The spin Hall effect of light (SHEL) describes the transverse splitting of an incident light beam into oppositely directed circularly polarized components, which occurs based on its spin direction when the light is reflected or refracted at an interface [1]. Initially, while the theory was well-established, experimental observation of the SHEL was challenging, which hindered the progress of research in this area. However, with the advent of weak measurement techniques and the use of metasurfaces, numerous studies on SHEL have been actively conducted. Applying these techniques has led to sensors with improved sensitivity compared to existing ones, and research is being extended to a wide range of materials. We have designed an indium tin oxide (ITO)-based SHEL controlled by an electric field and have demonstrated through simulations that different phenomena can be observed in on/off modes [2]. We conducted the experiments under circularly polarized incidence, and the metasurface nanostructure was designed based on anisotropic geometry. When applying circularly polarized incidence to the equation for calculating the spin Hall shift, it becomes independent of the reflection coefficient of the interface. In the off mode, we achieve high efficiency in handness-reversal, whereas in the on mode, we achieve high efficiency in handness-preservation, enabling dual-mode analysis for a single medium. Based on this, we anticipate that it will be possible to sense chiral molecules by measuring variations in optical rotation (OR).

References

[1] Kim, Minkyung, and Dasol Lee. "Strengthened Spin Hall Effect of Circularly Polarized Light Enabled by a Single-Layered Dielectric Metasurface." Materials 16.1 (2022): 283.

[2] Park, Junghyun, et al. "All-solid-state spatial light modulator with independent phase and amplitude control for three-dimensional LiDAR applications." *Nature nanotechnology* 16.1 (2021): 69-76.

Keywords: Spin Hall effect of light, Metasurface, Tunability, chiral molecule detection.

Radiative cooling fiber for thermal management of wearable healthcare devices

Changhwan Hyeon[1], Minseo Jeong[1], Seokgyu Kwon[1], Dasol Lee[1]*

[1] Department of Biomedical Engineering Yonsei University, Wonju, Korea.

*E-mail: dasol@yonsei.ac.kr

Wearable healthcare devices are becoming more closely integrated with human skin and play an essential role in bio signal monitoring and clinical treatments. These electronics require high performance and effective thermal management. Overheating, whether from internal heat generation or external absorption, can lead to performance issues, and safety risks for users. Thus, efficient thermal management is crucial for maintaining performance and safety [1]. Traditional thermal management methods dissipate heat through like cooling systems, increase device size and power consumption, limiting portability and wearability. Radiative cooling, on the other hand, offers an innovative solution by dissipating heat through radiation without extra power consumption, which is particularly effective in outdoor environments [2]. In this study, we make radiative cooling fibers (RC) by electrospinning to achieve high solar reflectivity and thermal emissivity. We integrated RC with health care devices to demonstrate an effective thermal management strategy. The RC shows high solar reflectivity, mid-infrared emissivity, and excellent mechanical flexibility. Outdoor tests revealed that RC integrated devices reduced temperatures by up to 6.3°C during operation, significantly improving thermal management. The flexibility of RC ensures enhanced cooling performance across various devices. Furthermore, the RC offers superior waterproofing, making it applicable for wearable devices that are exposed to outdoor heat and humidity.

References

[1] Kim, H. *et al.* Outdoor Worker Stress Monitoring Electronics with Nano fabric Radiative Cooler-Based Thermal Management. *Advanced Healthcare Materials* 12, (2023).
[2] Li, J. *et al.* Ultrathin, soft, radiative cooling interfaces for advanced thermal management in skin electronics. *Science Advances* 9, (2023).

Keywords: Radiative cooling, Wearable device, Electrospinning.

Metasurface-Based Lens Design for Rigid Endoscopic Laser Device

Kyunghyun Yu[1], Sangmin Shim and Dasol Lee[1]*

[1] Department of Biomedical Engineering Yonsei University, Wonju, Republic of Korea.

*E-mail: dasol@yonsei.ac.kr

The rigid endoscopic laser device is essential in surgery, but the material limitation of rigid endoscope devices makes the tip inflexible, preventing precise laser targeting. Conventional methods involved altering the tip's shape to steer the laser [1], but this required reinsertion into the body, leading to delays and inconvenience. The metalens can be proposed as a solution. The metalens can steer the laser through phase delay induced by its nanostructures and form dual focal points using polarizations [2]. The metalens were designed to create different focal points for left-handed circular polarization (LCP) and right-handed circular polarization (RCP), enabling a broader treatment range compared to conventional methods. The metalens form focal points at 0 degrees for LCP and 30 degrees for RCP. This was verified through 2D simulations using Rayleigh-Sommerfeld diffraction theory simulation. The metalens showed an 85.5% transmission rate for both LCP and RCP at the 1064nm wavelength. The lens size needed to adjust the angle to 30 degrees was 1mm(<3.5mm), proving its suitability for rigid endoscopes. In conclusion, the metalens have the potential to expand the treatment range of rigid endoscopic laser devices, reduce surgery time, and overcome the limitations of conventional methods. This approach improves both precision and efficiency in rigid endoscopic laser treatments.

References

[1] Perrone, J. M., Ames, C. D., Yan, Y. & Landman, J. Evaluation of surgical performance with standard rigid and flexible-tip laparoscopes. Surgical Endoscopy and Other Interventional Techniques 19, 1325–1328 (2005).

[2] Qu, J., Luo, H. & Yu, C. Dual-Wavelength Polarization-Dependent Bifocal Metalens for Achromatic Optical Imaging Based on Holographic Principle. Sensors 22, (2022).

Keywords: Rigid endoscopic laser device, Metalens, Steerability.

Radiative Cooling Nanofiber Materials with Menthol for Pruritus Relief and Skin Cooling in Atopic Dermatitis

Minseo Jeong[1], Seokgyu Kwon[1], Changhwan Hyeon[1] and Dasol Lee[1]*

[1] Department of Biomedical Engineering Yonsei University, Wonju, Korea.

*E-mail: dasol@yonsei.ac.kr

Atopic dermatitis (AD) is a chronic inflammatory skin disorder often exacerbated by elevated skin temperatures, particularly during warmer seasons, which intensifies pruritus and discomfort. This study presents the development of radiative cooling nanofiber materials using a PVA/Zein/Al_2O_3/SiO_2 composite. These nanofibers are designed to lower skin temperature via high emissivity in the mid-infrared (MIR) region and high reflectivity in the UV-VIS-NIR spectrum, promoting effective heat dissipation while reducing solar heat absorption. [1] The material, with the planned incorporation of menthol, is expected to significantly reduce skin surface temperature and alleviate heat-induced pruritus in AD patients. In the next phase of this research, menthol, a TRPM8 receptor agonist known for its cooling and antipruritic properties, will be incorporated into the nanofiber matrix. It is hypothesized that menthol will enhance the nanofibers' cooling effect and provide sustained pruritus relief, particularly in high-temperature environments. While experimental validation is forthcoming, menthol-infused radiative cooling nanofibers are anticipated to offer a dual therapeutic approach, addressing both thermal regulation and pruritus alleviation in AD. [2] This innovative material holds promise as an effective strategy for improving symptom management in AD, particularly during warm seasons, by targeting both skin temperature and pruritus.

References

[1] Dongliang Zhao. et al. “Radiative sky cooling: Fundamental principles, materials, and applications.” Appl. Phys. Rev 6. 021306 (2019).
[2] Reza Monfared-Hajishirkiaee. et al. “Peppermint essential oil and ZnO nanoparticles: A green and effective combination for a cooling bilayer patch with antibacterial activity.”, Journal of Environmental Chemical Engineering 12, 112833 (2024).

Keywords: Radiative cooling, Optics, Atopy, Biomaterials

Enhanced Energy Delivery Using Optical Fibers Integrated with Medical Needles for Advanced Low-Level Laser Therapy

Donghwan Ko, Seyoung Lee, Hyunseon Yu, and Byungjo Jung*

Department of Biomedical Engineering, Yonsei University, Wonju, Korea

*E-mail: bjung@yonsei.ac.kr

The growing interest in low-level laser therapy (LLLT) arises from its non-invasive nature and absence of adverse effects. Traditional low-level laser therapy (LLLT) has faced challenges due to a lack of established optimal parameters. To overcome this, the safety and optimal treatment parameters for brain photobiomodulation (PBM) therapy—such as wavelength, fluence, power density, repetition frequency, treatment duration, and light delivery mode (either continuous or pulsed)—are being extensively investigated in preclinical studies[1]. However, delivering the desired energy to targeted locations remains difficult. This issue arises because light scatters and reflects as it penetrates tissue, resulting in energy loss. To address this limitation, our study introduces a minimally invasive laser system integrating optical fibers with medical needles for precise deep tissue targeting. We developed a system by embedding a 105um optical fiber into a 25-gauge needle, using bovine samples to assess light transmission to deeper tissues and evaluate coagulation at various power outputs. Our results show that the system not only supports low-level therapeutic applications but also effectively induces coagulation or ablation in targeted tissues, providing adjustable and precise energy control for diverse medical interventions.

Acknowledgement : This research was supported by "Regional Innovation Strategy (RIS)" through the National Research Foundation of Korea(NRF) funded by the Ministry of Education(MOE) in 2024 (2022RIS-005)

References

[1] Salehpour, F., Mahmoudi, J., Kamari, F. et al, Mol Neurobiol 55, 6601–6636 (2018).

Keywords: Low Level Laser Therapy, Photobiomodulation, Light delivery

Facile synthesis of multi-stimuli responsive biocompatible trimethyl chitosan-based nanogel as potential nanocarrier for photothermal chemotherapy

Jun Hyeon Park[1], Su-Geun Yang[1]

[1] Department of Biomedical Science, BK21 FOUR Program in Biomedical Science and Engineering,College of Medicine, Inha University, Korea

*E-mail: sugeun.yang@inha.ac.kr

In this study, we developed a multi-stimuli responsive UCST-type PHEMA-TMC nanogel, responsive to pH and light. These nanogels, sized between 1 to 1000 nm, undergo structural changes due to multiple stimuli, allowing for controlled drug release applications. By integrating photothermal agents like sodium copper chlorophyllin (SCC), the nanogels convert absorbed light into localized heat, beneficial for photothermal therapy. Poly(2-hydroxyethyl methacrylate) (PHEMA) serves as the biocompatible thermoresponsive polymer, with its upper critical solution temperature (UCST) adjustable through copolymerization with cationic comonomers.[1] N,N,N-trimethyl chitosan (TMC), a partially quaternized derivative, acts as a cationic stabilizer and contains pH-responsive residues. The nanogels were synthesized using a soap-free emulsion polymerization method with riboflavin as a photoinitiator. The thermoresponsive properties varied based on the degree of TMC cationization, cross-linker amount, and pH. They encapsulated the anticancer drug honokiol and were loaded with SCC for dual benefits in chemotherapy and photothermal therapy. The synthesis involved a redox photoinitiating system, where TMC's tertiary amines generate free radicals, aiding polymerization. Photothermal studies showed that honokiol/SCC co-loaded nanogels significantly raised temperatures during laser irradiation.[2] In vitro release studies indicated that honokiol release was fastest at 50 °C/pH 5, supporting the potential of these nanogels for controlled drug release applications in response to environmental changes .

Acknowledgement : This research was conducted with the support of the Thailand Science Research and Innovation (TSRI), the National Research Council of Thailand (NRCT), and the National Research Foundation of Korea (NRF) project (NRF-2021H1D3A2A02045561).

References

[1] **Augé, A., Fortin, D., Tong, X., Zhao, Y.**. *Polym. Chem.*, 9, 4660–4673 (2018)
[2] **Chang, R., Hsu, C.-F., Tsai, W.-B. (2018).** *ACS Omega*, 3, 16057–16062.

Keywords: UCST, PHEMA, nanogel, honokiol, TMC, photothermal therapy

Laser Speckle Contrast Imaging for Implementation of Portable Optical Imaging System

Hyunseon Yu, Donghwan Ko, Seyoung Lee, and Byungjo Jung*

Department of Biomedical Engineering, Yonsei University, Wonju, Korea

*E-mail: bjung@yonsei.ac.kr

This study demonstrates an image processing algorithm for visualizing blood circulation using laser speckle contrast imaging (LSCI) technology based on Raspberry Pi. LSCI is a useful technology for non-invasively measuring and monitoring blood circulation in vivo [1]. Recent studies are exploring the possibility of using low-power computers, such as Raspberry Pi, to enhance the miniaturization and mobility of LSCI. A miniaturized optical imaging system was developed by transferring an existing MATLAB-based algorithm, which we had previously developed, to Python. The real-time processing capability for visualizing blood circulation was evaluated. A diode laser emitting light at 850 nm was used as a light source. To expand the illumination area, an optical diffuser was placed in front of the light source. Raspberry Pi camera module v3 NoIR, capable of near-infrared light collection, was utilized for image acquisition. A band pass filter passing only 850 nm range was mounted with Raspberry Pi camera to enhance the light to noise ratio. We designed and printed 3D mold for connection between optical components using a fused deposition modeling based 3D printer. The speckle contrast (K) can be calculated by the following equation: $K = \sigma/\langle I \rangle$, where σ is the standard deviation, and $\langle I \rangle$ is the mean intensity. There are two representative algorithms: spatial contrast, which is calculated based on a specific space between adjacent pixels, and temporal contrast, which is calculated based on changes over time at the same pixel location. To evaluate the feasibility of LSCI, optical phantom and human hand experiments were performed. Through the experiments, the difference in laser speckle contrast values was shown depending on the speed of flow. The processed images from MATLAB and Python showed a high correlation each other. In future studies, it will be necessary to improve the performance through verification in various environments and algorithm optimization.

Acknowledgement : This research was supported by "Regional Innovation Strategy (RIS)" through the National Research Foundation of Korea(NRF) funded by the Ministry of Education(MOE) in 2024 (2022RIS-005)

References

[1] W. Heeman et al., *Journal of Biomedical Optics*, 24, 8 (2019)

Keywords: Image Processing, Laser Speckle Contrast Imaging, Python

IP-046

Kctd17 as a novel target for the treatment of hepatocellular carcinoma

Yun Ji Lee[1,2,3], Sang Eun Kim[1,2,3], Young Hoon Jung[1,2,3], Kyung Hee Jung[1,3], Ah-Reum Oh[1,2,3], Yelin Jeong[1,2,3], HyunJoon Gi[1,2,3], Young Un Kim[1,2,3], KyeongJin Kim[1,2,3], Soon-Sun Hong[1,2,3,*]

[1]Department of Biological Sciences, College of Medicine, Inha University

[2]Program in Biomedical Science & Engineering, Inha University

[3]Research Center for Controlling Intercellular Communication (RCIC), College of Medicine, Inha University, Incheon 22212, Republic of Korea

*E-mail: hongs@inha.ac.kr

Potassium channel tetramerization domain containing 17 (Kctd17) protein, an adaptor for cullin3 (Cul3) ubiquitin ligase complex, is implicated in human diseases, yet its mechanism of action in hepatocellular carcinoma (HCC) remains unknown. We found that *Kctd17* expression is increased in tumors from HCC patients and mouse model of HCC, compared to them in non-tumor controls. We identified the leucine zipper-like transcriptional regulator 1 (Lztr1) protein, a previously identified Ras destabilizer, as a substrate for Kctd17-Cul3 complex [1]. Kctd17-mediated Lztr1 degradation leads to Ras stabilization, resulting in the increases of proliferation, migration, and wound healing of liver cancer cells. This process results in stabilization of the Ras oncogene and activated of Ras/Mitogen-activated protein kinase (MAPK) signaling. Thus, hepatocyte-specific *Kctd17* deficient mice or liver cancer xenograft models are less susceptible to liver carcinogenesis or tumor growth (IACUC Approval number: INHA200831-714-2). Treatment of *Kctd17*-directed antisense oligonucleotide (ASO) in mouse model of HCC markedly lowered tumor volume as well as the Ras protein levels, compared to control ASO-treated mice. Our study demonstrates that Kctd17 induces tumor progression via Ras stabilization.

Acknowledgments : This work was supported by the National Research Foundation of Korea (NRF) grants funded by the Korea goverment (MSIT) [No. RS-2023-00208008 to K.K, 2021R1A5A2031612 to S.S.H and K.K.]

Reference

[1] Steklov, M. et al. *Science* 362, 1177 (2018)

Keywords: HCC, KCTD17, Ras, Lztr1, Antisense oligonucleotides

Neural Electrode Fabrication Using Spin-Coated COC Film

Hwi Ahn1, Jong-Mo Seo1,2*

[1] Department of Electrical and Computer Engineering, Seoul National University, Seoul, Korea
[2]Biomedical Research Institute, Seoul National University Hospital, Seoul, Korea.

*E-mail: callme@snu.ac.kr

Chronic implant of neural electrode is essential for various applications. However, long-term reliability of neural electrodes should be further improved to be clinically used. Ideal substrate material for chronic neural electrode should present biocompatibility, adequate mechanical properties, and low water permeation [1]. Cyclic olefin copolymer (COC) is an amorphous polymer meeting these properties. Taking advantage of its thermal plasticity, COC based devices are fabricated thermally above its glass transition temperature [2]. However, thermally processed COC films are optically imperfect and bumpy. These problems can be resolved by dissolving COC into solvent, and fabricating electrode with the solution. In this study, spin coated COC films were implemented to fabricate neural electrodes. Spin speed was modified with 300rpm, 500rpm and 1000rpm. COC pellets were dissolved in cyclohexane. After spin coated films were prepared, titanium adhesive layer and gold layer were deposited on COC film. Metal patterned COC film and bare COC film were laminated in heat press to construct a complete device. When COC film was overly thin, the film was mechanically weak to fabricate neural electrode. Thin film was hard to detach from support layer, and it was perforated during metal deposition. Meanwhile, excessively thick films trapped cyclohexane, which resulted in bubble formation.

Acknowledgement : This research was supported by a grant of the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea (grant number : RS-2023-00304861). This work was supported by the Institute of Information & Communications Technology Planning & Evaluation(IITP)-Global Data-X Leader HRD program grant funded by the Korea government(MSIT)(IITP-2024-00441407). This research was supported by a grant of 'Korea Government Grant Program for Education and Research in Medical AI' through the Korea Health Industry Development Institute(KHIDI), funded by the Korea government(MOE, MOHW).

References

[1] P. Oldroyd and G. G. Malliaras, *Acta biomaterialia*, vol. 139, pp. 65–81 (2022)
[2] A. Agha et al., Macromolecular Materials and Engineering, vol. 307, no. 8, p. 2200053 (2022)

Keywords: Neural electrode, cyclic olefin copolymer, spin coating, cyclohexane

IP-048

독시사이클린 전달을 위한 코어-쉘 나노섬유 기관 스텐트: 금속단백분해효소 및 섬유증 형성 억제

Ngoc Thuan Truong[1], 양수근[1*]
인하대학교 바이오메디컬 사이언스 엔지니어링학과[1]

Core-Shell Nanofiber Tracheal Stent for Doxycycline Delivery: Inhibiting Metalloproteinase and Fibrosis Formation

Ngoc Thuan Truong[1], Su-Geun Yang[1*]
Department of Biomedical Science, BK21 FOUR Program in Biomedical Science and Engineering, College of Medicine, Inha University, Korea
*sugeun.yang@inha.ac.kr

Abstract

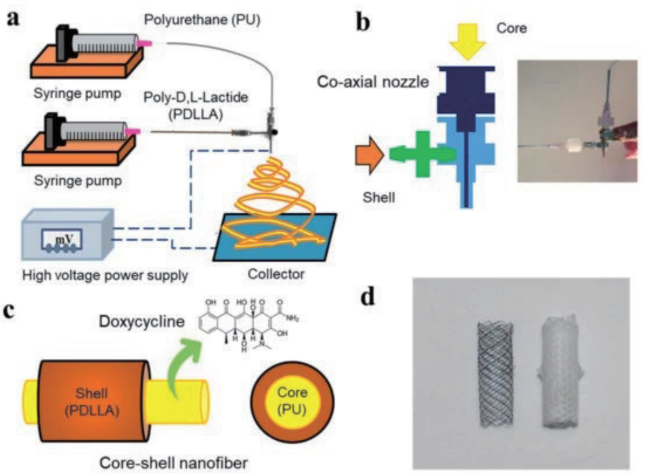
A nanofiber-coated endotracheal stent that releases doxycycline (doxy) was developed to mitigate fibrosis and restenosis associated with intubation. Poly (D,L-lactide) was chosen for the outer layer, while polyurethane formed the core. By modifying the electro-spray process of the polymer solutions, the core-to-shell ratios were adjusted to 1:0, 1:2, and 1:4. Microscopic techniques, such as scanning electron microscopy (SEM), transmission electron microscopy (TEM), and fluorescence microscopy, confirmed the nanofibers' core-shell structure. In vitro release tests showed that increasing the shell proportion allowed for controlled doxycycline release. Furthermore, nanofibers containing 10% doxycycline significantly inhibited HT1080 fibrosarcoma cell growth and reduced MMP-2 and MMP-9 expression. These results indicate that a doxycycline-eluting nanofiber stent may help prevent tracheal tissue fibrosis after stent insertion.

1. 연구 배경

Tracheal intubation involves placing a tube in the trachea to prevent airway obstruction, particularly during emergencies like respiratory failure, stroke, or coma [1,2,3]. However, this procedure can lead to complications such as restenosis and fibrosis due to stent-induced inflammation and tissue damage. Elevated levels of matrix metalloproteinases (MMPs), especially MMP-2 and MMP-9, contribute to these conditions, but existing inhibitors have shown limited efficacy in clinical trials [3]. Doxycycline, a broad-spectrum antibiotic, has demonstrated MMP inhibitory properties and is the only FDA-approved MMP inhibitor, potentially reducing infection-related inflammation during intubation [5]. This study developed a doxycycline-eluting core-shell nanofiber stent using electrospinning technology to treat tracheal stenosis, exploring various core-shell ratios and characterizing the nanofibers through microscopy techniques. The study assessed doxycycline release and evaluated MMP expression in HT1080 fibrosarcoma cells treated with nanofiber stents, supporting the hypothesis that this approach could effectively address tracheal stenosis.

2.연구 방법

A single-layer nanofiber was produced using a polyurethane (PU) polymer combined with doxycycline (doxy). Doxy was dissolved in a solution of N,N-dimethylformamide (DMF) and tetrahydrofuran (THF) in a 2:1 ratio. Following this, 30 mg of PU polymer (10% w/w) was added and mixed thoroughly until the solution became clear. This solution served as the core in a co-axial system. For the outer shell, poly (d,l-lactide) (PDLLA) was dissolved in the same solvent at a final concentration of 3.3% w/w. Doxycycline, equivalent to 10% w/w of the total polymer content, was dissolved in the core system. Prior to electrospinning, the polymer solutions were carefully prepared to ensure they were free of air bubbles and debris.



Scheme 1. Fabrication of core-shell electrospun nanofiber.
(a) Schematic diagram of core-shell electro-spinning nanofiber generating system.
(b) Design of co-axial nozzle for core-shell nanofiber generation.
(c) Schematic structure core-shell nanofiber (Doxy eluting PU (polyurethane) core and release controlling Poly(d,l-lactide) shell.
(d) Self-expanding bare metal stent (left) and doxy-eluting PU–PDLLA core-shell electrospun stent for animal test (the maximum external diameter is 6 mm).

3. 연구 결과

The morphology and corresponding diameters of the nanofibers were examined using microscopic imaging technologies (SEM, TEM, and fluorescence microscope).

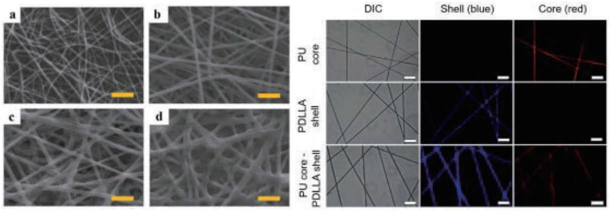
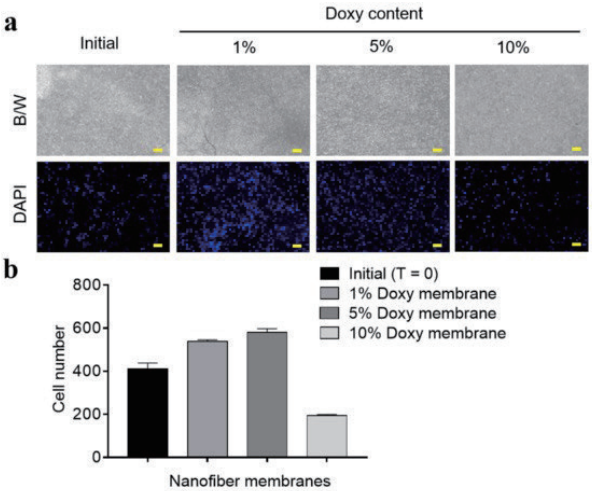


Figure 1. Scanning electron microscopic images of electrospun polyurethane (PU) single nanofiber (a) and PU core-PDLLA shell (1:1. 1:2 and 1:4) electrospun nanofiber (b–d,). Yellow scale bar=5 µm. Fluorescence microscopic images of nanofibers; images of single nanofiber of PU core (top, red fluorescence), PDLLA shell (middle, blue fluorescence) and PU core–PDLLA shell nanofiber (bottom, red fluorescence for core and blue fluorescence for shell). Blue and red fluorescence were acquired from 4′,6-diamidino-2-phenylindole (DAPI) and Nile red, respectively. Scale bar=20 µm.

We investigated the growth of fibrosarcoma cells on the nanofiber membranes, with the findings illustrated in Figure 2. DAPI staining demonstrated that the doxycycline-releasing nanofibers inhibit fibrosarcoma cell growth in a dose-dependent manner, with noticeable growth inhibition at the 10% doxy concentration.

Figure 2. Cell growth on the doxy-releasing nanofiber membrane.



(a) HT1080 mouse fibrosarcoma cells were placed on the nanofiber membrane of different doxy concentration, incubated for 72 h and stained with DAPI for fluorescence microscopy.

(b) Number of HT1080 cells after 72 h of incubation on the top of the doxy-eluting membrane. Number of cells was calculated using Image J software. Error bars indicate SEM (n = 3). *scale bar= 50 µm.

These results align with subsequent studies on MMP expression in both in vitro and in vivo models. No degradation of the core-shell nanofibers was observed during the dissolution or cellular disposition studies conducted in this research. Previous studies have examined nanofiber degradation, with Kim et al. noting that PU nanofibers co-incubated with cells partially lost their fibrous structure after three days. Regardless, it is anticipated that the nanofibers will degrade and be eliminated from the body following tissue intubation. In our study, we propose that the hydrophobic nature of the PDLLA shell plays a significant role in preserving the integrity of the nanofibers, ensuring that they maintain their structure for the complete release of doxycycline after tracheal intubation.

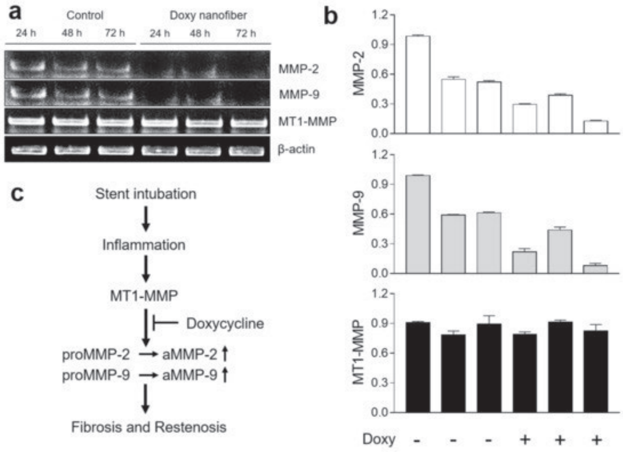


Figure 3. Effect of doxy-releasing nanofibers on MMP expression. HT1080 mouse fibrosarcoma cells were placed on the membrane incubated for 24, 48 and 72 h.

(a) Real-time PCR analysis shows MMP-2, MMP-9 and MT1-MMP mRNA levels.

(b) Relative MMPs activities were quantified in image J software. Doxy-releasing nanofiber inhibits mRNA levels of the MMP-2 and MMP-9.

(c) General molecular pathway of MMP expression and resulting tissue fibrosis after a stent intubation. Error bars indicate SEM (n = 3).

4. Acknowledgements

This research was supported by The Korea Research Fellowship Program, Basic Science Research Program and the Bio & Medical Technology Development Program through the National Research Foundation of Korea (NRF), funded by Korean government (MOE, and MIST) (2020R1I1A1A01073559, 2020R1A2B5B02002377, 2018R1A6A1A03025523, and 2019M3E5D1A02069623). Experimental materials were supplied by S & G Biotech Inc. (Gyeonggi-do, Korea) and Taewoong Medical Co., Ltd. (Gyeonggi-do, Korea).

5.참고 문헌

[1] Spittle, N.; McCluskey “A. Tracheal stenosis after intubation”. *BMJ* 2000, 321, 1000–1002

[2] Wassermann, K.; Mathen, F.; Edmund Eckel, H. “Malignant laryngotracheal obstruction: A way to treat serial stenoses of the upper airways”. *Ann. Thorac. Surg*. 2000, 70, 1197–1201.

[3] Mudambi, L.; Miller, R.; Eapen, G.A. “Malignant central airway obstruction”. *J.Thorac. Dis*. 2017, 9, S1087–S1110.

[4] Pavlaki, M.; Zucker, S. “Matrix metalloproteinase inhibitors (MMPIs): The beginning of phase I or the termination of phase III clinical trials”. *Cancer Metastasis Rev.* 2003, 22, 177–203.

[5] Choi, J.S.; Kim, J.M.; Kim, J.W.; Kim, Y.M.; Park, I.S.; Yang, S.G. “Prevention of tracheal inflammation and fibrosis using nitinol stent coated with doxycycline”. *Laryngoscope* 2018, 128, 1558–1563.

Analyzing the relationship between performance of ML and interpretability

Youngro Lee1 , Jongmo Seo1,2 *

1 Electrical and Computer Engineering, Seoul National University, Korea
2 Biomedical Research Institute, Seoul National University, Korea

*callme@snu.ac.kr

In the era of machine learning, many medical areas have utilized machine learning not only to make high performing predictive model but also to analyze what are important features, which has been done by statistics. However, there is not much of tools to analyze whether the interpretation of ML is right or not. A lot of papers analyzing the interpretation of ML does not provide justification of the analysis except the performance of ML. It is widely accepted that the interpretation of high performing model might be valid. In this study, we analyzed is this rule of thumb really right, or if not, what should be changed from the general idea. We degraded the performance by 1) data cutting and 2) feature cutting, and observed how the rank of features changes. We concluded that regardless of performance, lack of data influences the change of feature ranks. Hence, we propose to check whether the machine learning model is suffering from the number of samples rather than the performance.

Acknowledgement : This work was supported by the Institute of Information & Communications Technology Planning & Evaluation(IITP)-Global Data-X Leader HRD program grant funded by the Korea government(MSIT)(IITP-2024-00441407) This research was supported by a grant of 'Korea Government Grant Program for Education and Research in Medical AI' through the Korea Health Industry Development Institute(KHIDI), funded by the Korea government(MOE, MOHW).

References

[1] Scott M Lundberg and Su-In Lee. A unified approach to interpreting model predictions. Advances in neural information processing systems, 30, 2017.
[2] Lee, Youngro, Kyungjin Kim, and Jongmo Seo. "CLE-SH: Comprehensive Literal Explanation package for SHapley values by statistical validity." arXiv preprint arXiv:2409.12578 (2024).

Keywords: Machine Learning, Feature importance, Weak performance

Comparison of Decision Tree Classification Algorithms on EEG Data

Nayeon Lee and Jongmo Seo* (12 points)

Department of Electrical and Computer Engineering, Seoul National University, Seoul, Korea

*E-mail: yons24@snu.ac.kr

The electroencephalogram (EEG) is often used to diagnose and analyze epileptic seizures. As seizures are preceded by changes in EEG and seizure prediction from EEG data is a promising field of research. Machine learning is a popular tool in this area, and various algorithms from the classic support vector machine (SVM) to recent deep learning models are being tested. However, the comparison of models applied to different datasets is imperfect as the datasets themselves can act as a variable. In this paper we compared the precision of different machine learning algorithms on a single open dataset.

Acknowledgement : This work was supported by the Institute of Information & Communications Technology Planning & Evaluation(IITP)-Global Data-X Leader HRD program grant funded by the Korea government(MSIT)(IITP-2024-00441407). This research was supported by a grant of 'Korea Government Grant Program for Education and Research in Medical AI' through the Korea Health Industry Development Institute(KHIDI), funded by the Korea government(MOE, MOHW). This study utilized the Epileptic EEG Dataset created by Wassim Nasreddine, published on March 16, 2021, made available through the Mendeley Data (DOI: 10.17632/5pc2j46cbc.1), and made possible by NPRP grant # NPRP12S-0305-190231 from the Qatar National Research Fund (a member of Qatar Foundation). The findings achieved herein are solely the responsibility of the authors.

References (Maximum 2 References)

[1] Rasheed, Khansa et al. *IEEE reviews in biomedical engineering*, 14, 139-155 (2021)

Keywords: EEG, Machine learning, Random forest, Extra trees

Development of a Portable Near-infrared Imaging Device for Induction and Detection of Autofluorescence in Parathyroid Glands during Surgery

Buri Kim[1], Jong-Hyuk Ahn[2], Kyu Eun Lee[3], Changhoon Baek[1*]

[1]Department of Transdisciplinary Medicine, Seoul National University Hospital, Seoul, Korea
[2]Department of Surgery, Chung-Ang University Hospital, Seoul, Korea
[3]Department of Breast and Endocrine Surgery, Seoul National University Hospital, Seoul, Korea

*E-mail: chbaek@snu.ac.kr

Thyroidectomy often damages parathyroid glands (PG), which are visually indistinguishable from surrounding tissues, potentially resulting in permanent disability. Traditional methods, such as methylene blue dye, carry risks such as neurotoxicity [1]. Recently, near-infrared (NIR) autofluorescence imaging has been employed to identify PG, which emit light at 820 nm when exposed to 780 nm excitation light [2]. However, current devices have limitations, such as bulky setup or the absence of a visual interface.

In this study, an 820 nm LED was used to simulate PG autofluorescence. To address the limitations of existing systems, we developed a device that integrates light sources and a digital camera for real-time visualization of simulated PG and surrounding tissues. The system utilizes a 780 nm LED for excitation, a 940 nm infrared (IR) LED for background visualization, and an IR camera with a long-pass filter for isolating autofluorescence. The system is controlled by a Raspberry Pi 4 with a touchscreen and powered by a battery.

Testbed based experiment confirmed the device has potential to detect PG by sensing simulated autofluorescence. The system could minimize invasive procedures and surgical delays. However, residual excitation light reached the camera, requiring light intensity adjustments, highlighting the need for better wavelength separation. Future iterations may incorporate AI for automated detection, with clinical trials planned to evaluate the system's efficacy.

Acknowledgement: This work was supported by the National Research Foundation of Korea(NRF) grant funded by the Korea government(MSIT) (No.RS-2023-00276632 and No.2022R1F1A1059705).

References

[1] Patel et al., *Br J Surg, 99,* 1345 (2012).
[2] Paras et al*., J Biomed Opt, 16,* 067012 (2011).

Keywords: Parathyroid autofluorescence, NIR imaging, Intraoperative monitoring

Improvement of fall risk prediction using the short-form berg balance scale for self-assessment

Bo Bo kyaw[1], Jinseok Park[1], Suvin Lee[1], Yerim Shin[1], Byeonghee Kim[1], Tejin Yoon[1,*]

[1]Department of Smart Health Science and Technology, Kangwon National University, Chuncheon, Korea
[*]E-mail: tyoon@kangwon.ac.kr

Assessing fall risk is important for the elderly, who are at a higher risk of accidental falls. The Berg Balance Scale (BBS) consists of 14 items to measure balance and mobility. This study aims to investigate the feasibility of using OpenCV in conjunction with machine learning to evaluate the BBS through video analysis. The training process focused on items 6, 7, and 8, which were identified as critical elements in the BBS. Following the expert judgment manual, four individuals with different body types were recruited as healthy experimental participants. They enacted good, normal, and bad postures while facing the front camera, thereby creating training and test data sets. Each participant performed three enactments per item, and to ensure normalization, their outfits were changed for each enactment during data collection. The algorithm model was constructed utilizing YOLOv8, and the detection of human positions within the video footage enhanced the accuracy of the system. Preliminary findings indicate that appropriate machine learning techniques can effectively assess BBS scores from video, achieving high accuracy rates.

References

[1] Ta, C., & Jin, R. (2023, June). Exploring Machine Learning Techniques for Fall Risk Prediction using the Berg Balance Scale. In 2023 *IEEE World AI IoT Congress (AIIoT)* (pp. 0273-0277). IEEE.
[2] Wang, I., Li, P. C., Lee, S. C., Lee, Y. C., Wang, C. H., & Hsieh, C. L. (2023). Development of a Berg Balance Scale short-form using a machine learning approach in patients with stroke. *Journal of Neurologic Physical Therapy, 47*(1), 44-51.

Keywords: Falls, Berg balance scale, Open CV, Machine learning

Personal Identification Based on Footstep Sounds Using Machine Learning and MFCC

J. H. Hwang[1], Y. H. Kim[1], S. T. Sneha[1], S. Y. Choi[1], J. W. Lee[2], and Y. J. Park [1,2,*]

[1]Department of Smart Health Science and Technology, Kangwon National University, Chuncheon, Korea
[2]Department of Mechanical and Biomedical, Mechatronics Engineering, Kangwon National University, Chuncheon, Korea.

[*]E-mail: yjpark@kangwon.ac.kr

There are various methods for personal identification, such as facial recognition, iris recognition, and fingerprint recognition, which have been widely studied and applied in real life. Personal identification using footstep sounds has also been actively researched[1]. However, existing studies have limitations in identifying multiple individuals. This study aims to identify two individuals from mixed footstep sounds using machine learning. Footstep sounds were recorded indoors using a smartphone microphone, with participants limited to wearing slippers. The footstep data were preprocessed and labeled using MFCC (Mel-Frequency Cepstral Coefficient)[2]. Supervised learning was then performed on individual footstep sounds, and the trained model was used to identify individuals from mixed footstep sounds. Several machine learning models were employed, including MLP (Multi-Layer Perceptron), SVM (Support Vector Machine), Random Forest Classification, and Softmax Classification. The performance of these models was compared using Mean Accuracy and mAP (mean Average Precision).

Acknowledgement : Interdisciplinary Program in Department of smart health science and technology Major in Mechanical Engineering. This work was supported by Korea Institute for Advancement of Technology(KIAT) grant funded by the Korea Government(MOTIE, Korea, P0020616, The Competency Development Program for Industry Specialist).

References

[1] Itai, Akitoshi, and Hiroshi Yasukawa. *APCCAS 2006-2006 IEEE Asia Pacific Conference on Circuits and Systems*, 992-995 (2006)
[2] Sahidullah, Md, and Goutam Saha. Speech communication 54.4, 543-565 (2012)

Keywords: Machine learning, Personal identification, footstep sound, MFCC

IBEC1. Yonsei University Mirae Campus

BK21 FOUR Education and Research Center of NBIT-integrated Medical System for Personalized Healthcare

Chair: Prof. Hye Jin Kim Yonsei University

November 7, 13:15~15:15, Main Building 2F Peacock

Bryan Yoon New York University School of Medicine
Neuroimaging in Psychiatric Disorders: Historical Insights and Future Directions

Dongjun Jung Massachusetts Institute of Technology. MIT
Soft metallic bioelectronics for medical applications

Myeongsu Seong Xi'an Jiaotong-Liverpool University
Classification of Alzheimer's and age-matched animal using hemodynamic signals during hypoxic gaschallenge

Inki Kim Department of Biophysics, Sungkyunkwan University
Metasurfaces for biosensing, molecular diagnostics, and biomedical imaging

Jinsik Kim Department of Biomedical Engineering, Dongguk University
Semiconducting Nanomaterials Based Devices for Understanding Neurodegenerative Diseases

윤영우 / Bryan Yoon

임상 강사/ Clinical Instructor

뉴욕대학교, 소아청소년정신과 /
Department of Child and Adolescent Psychiatry,
New York University School of Medicine, New York, NY, USA.

Neuroimaging in Psychiatric Disorders: Historical Insights and Future Directions

Abstract:

Advancements in magnetic resonance imaging (MRI) technology have provided high-resolution images of brain structure without the use of ionizing radiation, and MRI began to be used in psychiatric research in the 1980s. As MRI technology progressed, its applications expanded to include functional MRI, which measures brain activity by detecting changes in blood flow. This development allowed researchers to explore functional aspects of brain activity. MRI has also been utilized to investigate white matter integrity and measure biochemical changes in the brain across various mental illnesses, including psychotic disorders, mood disorders, neurocognitive disorders, and neurodevelopmental disorders, further enhancing our understanding of psychiatric disorders. Recently, from a precision medicine perspective, the future of MRI in psychiatric disorders is poised to revolutionize diagnosis and treatment by identifying specific brain biomarkers associated with individual conditions, leading to more accurate and personalized approaches to mental health care. Ultimately, these advancements will support the shift towards precision psychiatry, where treatments are customized based on the unique neurobiological makeup of each patient, improving outcomes and reducing trial-and-error approaches in mental health care.

Brief Biosketch

Bryan Yoon, MD, PhD, earned his Bachelor of Science in Biomedical Engineering from Hanyang University. He then completed medical school at Kyungpook National University School of Medicine, where he obtained his MD, and earned his PhD in Brain and Cognitive Sciences from Seoul National University. After finishing his psychiatry residency training at Case Western Reserve University, Dr. Yoon is currently a Clinical Instructor in the Department of Child and Adolescent Psychiatry at New York University School of Medicine. His research has particularly focused on neuroimaging studies, and he obtained his PhD with a thesis titled, 'Changes in Functional Brain Networks in Individuals at Clinical-High Risk for Psychosis and with First-Episode Psychosis'.

성명수 / Myeongsu Seong
조교수 / Assistant Professor
Xi'an Jiaotong-Liverpool University
Department of Mechatronics and Robotics, School of Advanced Technology

Classification of Alzheimer's and age-matched animal using hemodynamic signals during hypoxic gas challenge

Abstract

Alzheimer's disease (AD) is one of the most devastating brain diseases. Conventional diagnostic methods of AD frequently are costly or require a relatively long time. In this work, a hypoxic gas challenge (supply of 16% oxygen balanced by nitrogen gas), which was used to mimic breath holding, was used to induce a hemodynamic response to Alzheimer's animal model (5xFAD, n=6) and age-matched animals (n=6). The hemodynamic signals, including the relative concentration of oxygenated and deoxygenated hemoglobin, were acquired from the animals using diffuse optical spectroscopy noninvasively. From the hemodynamic signals, multiple hemodynamic features, inspired by hemodynamic features used in breast cancer studies of diffuse optical tomography and dynamic contrast-enhanced magnetic resonance imaging, were extracted and used to classify the two groups. Some of the features could differentiate the groups statistically significantly (p-value <0.05). Additionally, multiple machine learning algorithms were tested to classify the two groups. Among various algorithms, the Naïve Bayes algorithm could achieve 84% accuracy (95% confidence interval: [83.8, 84.8]). The results show that the suggested approach has potential as an alternative method for the classification of Alzheimer's and non-Alzheimer's groups.

Brief Biosketch

Dr. Myeongsu Seong is currently working as an Assistant Professor at the Department of Mechatronics and Robotics, School of Advanced Technology, Xi'an Jiaotong-Liverpool University (XJTLU) from August 2023. In 2018, Dr. Seong received his Ph.D. from the Department of Biomedical Science and Engineering, Gwangju Institute of Science and Technology, Gwangju, Republic of Korea. Before joining XJTLU, Dr. Seong worked as an Associate Professor and a postdoc at Nantong University, China, and Shanghai Jiao Tong University, China, respectively. Dr. Seong has received multiple awards and distinctions including Young Foreign Talent Plan of National Foreign Expert Project from the Ministry of Science and Technology of China and Global Ph.D. Fellowship from the National Research Foundation of Korea. Dr. Seong's research interest includes the development of new opto-mechatronic imaging/spectroscopic and therapeutic systems that can be used in both preclinical and clinical studies, relevant signal/image processing methods, and applications of the developed systems in neurology or oncology studies for the translation of the systems to the clinics.

김인기 / Kim, Inki
조교수 / Assistant Professor
성균관대학교 / Sungkyunkwan University
생명물리학과 / Department of Biophysics

Metasurfaces for biosensing, molecular diagnostics, and biomedical imaging

Abstract: In this talk, I will introduce metasurface-enhanced multiplexed nanospectroscopy, molecular diagnostics and biomedical imaging technologies. First, we report metasurfaces-driven hyperspectral imaging via multiplexed plasmon resonance energy transfer (PRET) to probe biological light-matter interactions, which can detect quantum biological electron transfer (QBET). Second, I will introduce a dielectric metalens device of submicrometer thickness for integrating single molecule on-chip sensors for point-of-care testing and quantum coherence energy transfer. The high numerical aperture, high focusing efficiency, and dual-wavelength operation of the metalens enables the implementation of fluorescence correlation spectroscopy with a single Alexa 647 molecule in the focal volume. Third, I will show a fast metaphotonic PCR device composed of a metamaterial perfect absorber that can rapidly go through thermocycling steps using a single infrared LED for quantitative studies of quantum enzymology. Last, I will present multimodal biomedical imaging technologies like phase contrast imaging or edge detection for cell and tissue morphology analysis and multifunctional photoacoustic microscope for label free volumetric imaging.

Brief Biosketch

Assistant Professor, Department of Biophysics, SKKU, Korea (2021.08)
Ph.D., Department of Mechanical Engineering, POSTECH, Korea (2021.02)
B.S., Department of Mechanical Engineering, UNIST, Korea (2015.02)
Research interests: Nanophotonics, Biophotonics, Metamaterials, Plasmonics, Nanofabrications

김진식 (Kim, Jinsik)
교수/Professor
동국대학교 의생명공학과
Dongguk University, Department of biomedical Engineering

Semiconducting Nanomaterials Based Devices for Understanding Neurodegenerative Diseases

Abstract
The field of nanomaterial-based sensors once focused on achieving the world's best limits of detection (LOD) and sensitivity. However, challenges in clinical applicability have since shifted the focus toward developing devices with enhanced repeatability and reproducibility. This shift is particularly crucial in the context of neurodegenerative diseases, where a multitude of factors can influence disease progression, and comprehensive, life-cycle analysis is required. To address these challenges, we aim to introduce semiconductor-based devices designed specifically for the analysis of neurodegenerative diseases. These devices offer improved reliability, enabling consistent and reproducible measurements, which are critical for both research and clinical applications. Through this presentation, we will explore the development of such devices and propose a novel approach for analyzing neurodegenerative diseases, offering potential breakthroughs in diagnosis and monitoring.

Brief Biosketch

Prof. Jinsik Kim received the B.S. and Ph.D degree in electrical engineering from Korea University, Seoul, Korea in 2007 and 2014, respectively. He was a national presidential scholarship student in B.S degree course. And he was a senior researcher of Korea Institute of Industrial Engineering from 2016 to 2017. Finally, he joined Department of Biomedical Engineering, Dongguk University at 2017. His researching interests are nanomaterials, electrochemical, stretchable, microfluidics, biosensors and bio electrical engineering.

IBEC2. Kangwon National University

BK21 Smart Healthcare Technology

Chair: Prof. Byung Hee Kim Kangwon National University

November 7, 15:45~17:45, Main Building 2F Peacock

Jaewon Lee University of Missouri
Understanding self-assembly through Population Balance Theory

Jae Hoon Sim Department of Otorhinolayngology, University Hospital Zurich
Prediction of surgical outcomes of middle-ear implants at development stages

Il Doh KRISS, Medical Metrology Group
Measurement Standards for Medical Devices in KRISS

ByeongHee Kim Kangwon National University
Real-time drowsy driving detection system through driver fatigue prediction based on face tracking

Prediction of surgical outcomes of middle-ear implants at development stages

Jae Hoon Sim[1]

[1]Department of Otorhinolaryngology, Head and Neck Surgery, University Hospital Zurich, University of Zurich, Zurich, Switzerland

.

E-mail: jaehoon.sim@usz.ch

The middle ear (ME) of humans converts sound waves in the ear canal into vibration of the cochlea fluid, matching a large impedance difference between air and cochlear fluid. The linkage of the ME ossicular chain can be interrupted and/or broken by various diseases or accidental trauma. The damaged ME is frequently repaired by ME implants, which are surgical reconstructions to replace the impaired structures with ME prostheses. To fit various pathological conditions and overcome anatomical variation. the expected surgical outcomes need to be predicted at the development stage, and thus various measurement techniques have been used to measure object quantities as indexes of the expected surgical outcomes. We have developed novel methods to predict the surgical outcomes of new ME surgical techniques and prostheses. The methodological approaches include spatial inspection of the reconstructed ME using micro-CT and microscopy, measurements of quasi-static and vibrational motions of the ME structures and/or prosthesis, and volumetric motion of the round window memebrane using laser Doppler vibrometers, and monitoring intracochlear pressures using a custom-made hydrophone. The established methodologies have been applied to cadaveric samples, custom-made physical models of the human ME, and live human subjects intraoperatively, to assess the new surgical techniques and prostheses at the development stage and early stage of the clinical application.

References

[1] Warnholtz B, Schär M, Cuny P, Sonntag K, Beutner D, Dobrev I, Röösli C, Sim JH. Audiology and Neurotology 26 (2021)

[2] Schär M, Dobrev I, Röösli C, Huber AM, and Sim JH. Hearing Research 430 (2023)

Keywords: Middle ear, Middle-ear implants, Middle-ear prostheses

Measurement Standards for Medical Devices in KRISS

Il Doh*, Changwoo Lee, and Hyo-Min Cho

Medical Metrology Group, BioMedical Metrology Division,
Korea Research Institute of Standards and Science (KRISS)

*E-mail: il.doh@kriss.re.kr

The Korea Research Institute of Standards and Science (KRISS), as the national metrology institute, establishes the primary measurement standards for the International System of Units. The R&D activities in Medical Metrology Group at KRISS focus on improving the reliability of measurements related to the human body and human-derived materials, while also validating the performance and safety of medical devices, to improve diagnostic accuracy and therapeutic effectiveness. This presentation will introduce recent three research projects conducted by the Medical Metrology Group: 1) an oscillometric waveform simulation system for calibrating and validating automatic non-invasive blood pressure monitors; 2) a tissue-mimicking phantom integrated with a thin-film temperature sensor array for the safety assessment of therapeutic devices including High-Intensity Focused Ultrasound (HIFU); and 3) a modular mapping phantom for the quality control of medical imaging devices. In summary, the Medical Metrology Group's research plays a important role in enhancing measurement reliability and verifying the safety and performance of medical devices, thereby contributing to the provision of better healthcare services and improving the quality of life for the public.

Acknowledgement : This work was supported by the Korea Research Institute of Standards and Science (KRISS).

References

[1] I. Doh et. al., Metrologia, **Vol.52**, 291 (2015)
[2] H.-M. Cho et. al., Scientific Reports, **Vol.10**, 14755 (2020)

Keywords: Medical Metrology, Measurement Standards, Medical Device Reliability

Real-time drowsy driving detection system through driver fatigue prediction based on face tracking

Chunmuk Jo[1], Chayeop Kim[1], Yenna Cha[1] Youngho Seo[1,2] and Byeonghee Kim[1,2,*]

[1]Department of Mechanical Convergence Engineering, Major in Mechatronics Engineering, Kangwon National University, Chuncheon, Korea
[2]Department of Smart Health Science and Technology, Kangwon National University, Chuncheon, Korea

[*]E-mail: kbh@kangwon.ac.kr

Drowsy driving accounts for approximately 2% of all traffic accidents, yet it leads to disproportionately higher fatalities due to the driver's reduced control and delayed response. The risk of fatal accidents is more than twice that of other traffic incidents, primarily due to cognitive decline caused by factors such as extended driving durations and sleep deprivation. Globally, various countermeasures have been implemented and become widespread, including safety devices like lane departure warning systems. In this study, we propose a real-time drowsy driving detection system using an AI model that predicts driver fatigue based on facial tracking data. Utilizing an infrared camera embedded in a Virtual Reality Head Mounted Display(VR HMD), we monitor and capture subtle facial movements, particularly around the eyes and mouth. Facial expressions, such as blinking and frowning, are linked to virtual Metahuman images, allowing for real-time detection of the driver's fatigue state. This technology has over 95% synchronization accuracy in facial expression tracking and is connected in real time to a 3D simulation engine via a live-link plug-in. We constructed a driver fatigue dataset(2,400 metahuman-synced images) and implemented an object detection AI model to classify fatigue. When fatigue is detected, the system triggers an audible alert to notify the driver. Model performance was validated using K-fold cross-validation and mAP metrics.

Acknowledgement : This research was supported by “Regional Innovation Strategy (RIS)” through the National Research Foundation of Korea(NRF) funded by the Ministry of Education(MOE) in 2024 (2022RIS-005).

References

[1] Kim Keun Tae. et al. Journal of sleep medicine, 13(2), 35-39 (2016)

Keywords: VR HMD, Face tracking, 3D simulation engine, Object detection

IBEC3. Korea University

BK21 FOUR Institute of Precision Public Health

Chair: Prof. Honggu Chun Korea University

November 8, 09:00 ~ 11:00, Main Building 2F Peacock

Mengdi Han (Dept of Biomedical Engineering, Peking University)
Magnetic implants for wireless biosensing

Jinhwan Kim (Dept of Biomedical Engineering, UC Davis)
Non-invasive, real-time tracking of cell-based therapies

Ngo Thi Lua (Dept of Biomedical Engineering, Vietnam National University)
AI in revolutionizing mental health

Andy Tay Kah Ping (National University of Singapore)
Nanostraw Electro-actuated Transfection (NExT) for non-viral, high-throughput genetic engineering of diverse primary immune cells

Okju Kim (ATG Lifetech)
RNA-Seq Based Verification of Organoid Generation Reproducibility for Precision Medicine

Magnetic implants for wireless biosensing

Mengdi Han*

Department of Biomedical Engineering, Peking University, Beijing, China
*E-mail: hmd@pku.edu.cn

Implantable sensors can directly interface with various organs for precise evaluation of health status. However, extracting signals from such sensors mainly requires transcutaneous wires, integrated circuit chips, or cumbersome readout equipment, which increases the risks of infection, reduces biocompatibility, or limits portability. Here, we develop a set of millimeter-scale, chip-less, and battery-less magnetic implants paired with a fully integrated wearable device for measuring biophysical and biochemical signals [1]. The wearable device can induce a large amplitude damped vibration of the magnetic implants and capture their subsequent motions wirelessly. These motions reflect the biophysical conditions surrounding the implants and the concentration of a specific biochemical depending on the surface modification. Experiments in rat models demonstrate the capabilities of measuring cerebrospinal fluid (CSF) viscosity, intracranial pressure, and CSF glucose levels. This miniaturized system opens the possibility for continuous, wireless monitoring of a wide range of biophysical and biochemical conditions within the living organism.

Acknowledgement: This work was supported by the National Natural Science Foundation of China (no. 62104009).

References (Maximum 2 References)

[1] Wan J. et al. Science Advances, **10**, eadm9314 (2024).

Keywords: Implantable sensor, wireless sensor, magnetic device

Non-invasive, real-time tracking of cell-based therapies

Tasneem Mukkarama[1,2], Marshall Lammers[2], Robert J. Canter[2], and Jinhwan Kim[1,2,*]

[1]Department of Biomedical Engineering, University of California Davis, Davis, CA, USA
[2]Department of Surgery, School of Medicine, University of California Davis, Sacramento, CA, USA.

[*]E-mail: jjnkim@ucdavis.edu

Recent advancements in nanomedicine have shown the potential of the integration of nanomaterials with endogenous cells to enhance therapeutic delivery and overcome biological barriers [1]. By functionalizing therapeutic cells with nanoparticles, these cells acquire unique physicochemical properties that allow real-time tracking and manipulation. Ultrasound-guided photoacoustic (US/PA) imaging represents a promising technique for in vivo monitoring of these nanoengineered cells. This dual-modality approach combines the deep tissue penetration of ultrasound with the high spatial resolution of photoacoustic imaging, enabling precise visualization of injected cells [2]. Nanoparticles enhance the optical contrast for photoacoustic signals, while ultrasound provides anatomical guidance, facilitating the accurate monitoring of cell distribution and behavior. Additionally, this approach allows for controlling cell functions, offering a novel strategy to improve the efficacy and safety of cell-based therapies [3]. In this presentation, we will discuss two examples demonstrating how the integration of functional nanoparticles with therapeutic cells can advance T cell-based and natural killer (NK) cell-based cancer immunotherapies. Our findings reveal that nanoengineered T and NK cells can be successfully detected in vivo at pre-clinical injection doses and can serve as predictors of cancer immunotherapy success by ensuring the initial infiltration of these cells into tumor masses.

Acknowledgement : This work was supported by the US National Institute of Health (NIH)/National Cancer Institute (NCI) (K99 CA263016, R00 CA263016, P30 CA093373) and UC Davis Reaching Across the Causeway Award.

References

[1] Mukherjee P. et al. *ACS Nano* ***16***, 15653 (2022)
[2] Kim J. et al. *Photoacoustics* ***25***, 100307 (2022)
[3] Jhunjhunwala A. et al. ACS Nano ***17***, 17931 (2023)

Keywords: photoacoustic imaging, T cell therapy, NK cell therapy, nanoparticles

AI in revolutionizing mental health

Huy Bao Hoang[1], Lua Thi Ngo[1,*]

[1] School of Biomedical Engineering, International University, Vietnam National University, HCMC, Vietnam

[*]E-mail: ntlua@hcmiu.edu.vn

Mental health disorders, including bipolar disorder, major depressive disorder, and schizophrenia, present significant diagnostic challenges due to overlapping symptoms. This research explores two innovative AI-based approaches for objective and accurate diagnosis of mental disorders using different data sources: electroencephalography (EEG) signals and activity tracking data from tracking sensors. In the first study, EEG data from 383 subjects (67 bipolar disorder, 199 major depressive disorder, 117 schizophrenia) were analyzed using a three-step method: (1) SMOTE up-sampling for dataset balancing, (2) key feature extraction, and (3) application of Machine Learning and Deep Learning models. The combination of Independent Component Analysis, ANOVA F-value, and Gradient Boosting achieved the highest accuracy of 96.67% in distinguishing between the three disorders. The second study focused specifically on depression detection using activity tracking data from 55 subjects (23 with depressive disorders, 32 controls). Two machine learning models, XGBoost and Artificial Neural Networks (ANN), were compared after data preprocessing, normalization, and augmentation. The XGBoost model, optimized using Bayesian Optimization, outperformed ANN with 87% accuracy on a per-sample basis and 100% accuracy for patient-level diagnosis, compared to ANN's 83% and 90% accuracy, respectively. Both studies demonstrate the potential of AI-powered analysis in mental health diagnostics. The integration of EEG analysis and activity tracking data demonstrates the potential for non-invasive, continuous monitoring of mental health states, enabling earlier detection and more personalized treatment plans. These AI applications contribute significantly to the development of low cost, quantitative, and accurate tools for mental health monitoring and diagnosis, potentially improving early intervention and treatment outcomes. These studies exemplify how technology is revolutionizing mental health care Furthermore, these technological advancements are paving the way for remote mental health assessments, potentially increasing accessibility to mental health services, especially in underserved region and country. The high accuracy rates achieved by these AI models suggest a future where technology can significantly reduce misdiagnoses, leading to more effective and timely interventions. As these technologies continue to evolve, we promise to transform the landscape of mental health care, offering more precise, objective, and accessible diagnostic tools that can complement clinical expertise and improve patient outcomes.

Keywords: bipolar disorder, schizophrenia, major depressive disorder, artificial intelligence, electroencephalography

Nanostraw Electro-actuated Transfection (NExT) for non-viral, high-throughput genetic engineering of diverse primary immune cells

Andy Tay[1,2,*]

[1]Department of Biomedical Engineering, National University of Singapore
[2]Institute of Health Innovation & Technology, National University of Singapore

[*]E-mail: bietkpa@nus.edu.sg

Chimeric Antigen Receptor-T (CAR-T) cell therapy relies on genetically modifying T lymphocytes to express a tumor targeting receptor for tumor elimination in patients. Gold standard viruses and bulk electroporation which are clinically used to transfect T cells offer low net transfection efficiency and reduce cell quality, leading to delayed, less efficacious, and more costly treatments. Here, we describe the Nanostraw Electro-actuated Transfection technology (NExT) which uses high aspect-ratio nanostraws coupled with localized electric fields to precisely inject biomolecules into cells in a minimally perturbative manner. We demonstrate the ability of NExT to deliver proteins, polysaccharides and mRNA into CD8+ T and CD4+ T cells and achieve CRISPR/Cas9 gene knockout of CXCR4 and TRAC gene loci in human CD8+ T cells. To emphasize the versatility of NExT, we also used the platform to transfect a diverse plethora of primary immune cell types including CD4+ T cells, γδ-T cells, macrophages, dendritic cells, Natural Killer cells, regulatory T cells, and neutrophils which are actively being developed as alternatives to CD8+-based CAR-T cell therapy. For the first time, we overcame the limitation of poor scalability associated with using nanostructures for transfection by engineering a high throughput multiwell NExT system capable of transfecting more than 14 million cells and delivering various cargo species into multiple cell types from different donors simultaneously.

Acknowledgement : This work was supported by the NUS Presidential Young Professorship, Ministry of Education Tier 1 Grant, National Medical Research Council Open Fund Young Investigator Research Grant, Manufacturing, Trade and Connectivity Young Investigator Research Grant, Singapore Therapeutics Development Review Pre-Pilot Grant and iHT OOE award

Keywords: Nanostructures; transfection; immuno-engineering

RNA-Seq Based Verification of Organoid Generation Reproducibility for Precision Medicine

Okju Kim[1], Yushin Jung[1], Yoobin Lee[1], Soobin Kim[1], Zhen Qi[2], Zhanguang Zuo[2], Shuge Guan[2], Idil Arioz[3], Weidi Gu[2], Rosanna Zhang[2] and Taehoon Ryu[1*]

[1] ATG Lifetech Inc., Seoul, Korea
[2] ACROBiosystems, Beijing, China
[3] ACROBiosystems AG, Basel, Switzerland

*E-mail: thryu@atglifetech.com

Organoids, three-dimensional structures derived from stem cells, are valuable models for mimicking human organs. Their ability to replicate the physiological and functional characteristics of human tissues makes them highly useful for applications in drug development and therapeutic efficacy testing. To fully realize their potential in precision medicine, it is essential to verify the reproducibility of organoid production, reducing batch-to-batch variability and ensuring consistent quality across experiments. Current approaches for assessing organoids often rely on microscopy or RT-qPCR, which provide limited insights by focusing on a few stage-specific markers. This study introduces an RNA sequencing (RNA-seq) based verification method to assess whole-transcriptome profiles, offering a more comprehensive evaluation of organoid consistency. Using heart organoids from ACROBiosystems as a model, this approach demonstrates its ability to detect subtle transcriptional variations that traditional methods may overlook. By enhancing reproducibility and reducing variability both within and between batches, RNA-seq based verification strengthens the reliability of organoid models, supporting their application in drug testing and regenerative medicine, which are key aspects of precision medicine.

Acknowledgement : This work was supported by the Industrial Strategic Technology Development Program (20024391, Development of a Personalized Breast Cancer Diagnosis and Treatment Technology-Product Using Single-Cell Multi-Omics Analysis and In Situ Sequencing of Circulating Tumor Cells) funded By the Ministry of Trade, Industry & Energy (MOTIE, Korea).

References

Keywords: RNA sequencing, Organoid, Precision medicine

IBEC4. Inha University

BK21 FOUR Precision Medicine & Smart Engineering

Chair: Bongseob Shim Inha University, **Soo Geun Yang** Inha University

November 8, 16:15 ~ 18:15, Main Building 2F Peacock

Sang Taek Jung School of Chemical and Biological Engineering, College of Engineering, Seoul National University
A Portfolio of Engineered Fc Variants for Enhancing Potency, Silencing Effector Functions, or Extending the Half-Life of Therapeutic Antibodies

Gan Ken En Samuel College of Science and Technology, Wenzhou-Kean University
Antibody Engineering of therapeutic antibodies: Understanding the elements involved in recombinant production, superantigen/antigen-binding and IgE-mediated allergy responses

Peerapat Thongnuek Chulalongkorn University
Light-responsive nanoparticles for drug delivery

Kwangsoo Shin Department of Polymer Science & Engineering, Inha University
Investigating the Impact of Polymer Branching on Nano-Bio Interactions

Yun Suk Huh Department of Biological Engineering, Inha University
Generation and Control of Bioplasma-based Bioactive Species for the Development of Next-Generation Cancer Immunotherapy

정상택/Sang Taek Jung

부교수/Associate Professor

서울대학교 공과대학 화학생물공학부/School of Chemical and Biological Engineering, College of Engineering, Seoul National University
Institute of Chemical Processes, Seoul National University, Seoul, 08826, Republic of Korea

A Portfolio of Engineered Fc Variants for Enhancing Potency, Silencing Effector Functions, or Extending the Half-Life of Therapeutic Antibodies

Abstract:

In the evolving field of therapeutic antibodies, the Fc (fragment crystallizable) region plays a pivotal role in determining efficacy by modulating immune effector functions and pharmacokinetic properties. Although IgG antibodies inherently possess the ability to recognize and neutralize a wide range of pathogenic antigens, achieving optimal clinical outcomes requires precise adjustments to their therapeutic potency, safety profile, and circulating half-life. This presentation outlines our innovative strategy to push the boundaries of traditional monoclonal antibody therapies through targeted engineering of the Fc region. We present an extensive portfolio of engineered Fc variants designed to either enhance or suppress effector functions, including antibody-dependent cellular cytotoxicity (ADCC), antibody-dependent cellular phagocytosis (ADCP), and complement-dependent cytotoxicity (CDC), along with variants engineered to prolong serum half-life. Utilizing a diverse set of genetic, cellular, and evolutionary engineering techniques, our research details the development and characterization of these Fc variants. The results highlight the potential of our engineered antibodies to deliver improved therapeutic efficacy and pharmacokinetic profiles, thereby setting the stage for the next generation of antibody therapeutics with superior clinical outcomes

Brief Biosketch

With over 25 years in the biopharmaceutical field, Dr. Sang Taek Jung has leveraged protein engineering and high-throughput techniques to address human health challenges. His research focuses on developing platforms for novel biomedical protein discovery, enhancing therapeutic proteins' efficacy and serum half-life, and applying immunology to next-generation immunotherapeutics. Dr. Jung received his B.S. and M.S. degrees from Seoul National University in 1997 and 1999. After working at Green Cross Corporation and Samyang Genex from 1998 to 2004, he earned his Ph.D. from the University of Texas at Austin in 2009 under Professor George Georgiou. He then conducted postdoctoral research with Professor Frances H. Arnold (2018 Nobel Laureate) at Caltech. Before joining Seoul National University as a faculty member in 2024, he served as a professor at Korea University and Kookmin University. Dr. Jung has filed over 200 patents and, since 2018, has achieved technology transfers totaling over 27 million dollars across 11 cases with 8 companies.

GAN KEN EN SAMUEL
Research Professor
Wenzhou-Kean University
Associate Fellow, British Psychological Society; Senior Fellow of Advance HE (formerly Higher Education Academy), UK; Adjunct Associate Professor of Psychology, James Cook University.

Antibody Engineering of therapeutic antibodies: Understanding the elements involved in recombinant production, superantigen/antigen-binding and IgE-mediated allergy responses

Abstract:
Antibody engineering has transformed targeted therapies, with monoclonal antibodies like Herceptin® and Perjeta® achieving success in treating Her2-positive cancers. This research explores how structural modifications—such as changes in light chains, VH-VL pairings, and constant regions—impact antibody expression, purification, antigen binding, and receptor interaction, highlighting the need for a new approach in therapeutic antibody design.
Humanization, critical for reducing immunogenicity, is often limited by current methods that focus on basic factors like production and binding while neglecting key aspects like localization and immune activation. Addressing these issues early can prevent adverse reactions in clinical trials.
Epitope selection is equally crucial, with targeted approaches using specific epitopes improving antibody effectiveness and resistance to escape mutations. Computational models predicting antigenic changes further enhance this process. This presentation summarizes a decade of research, offering a framework for optimizing antibody engineering to improve therapeutic outcomes and reduce side effects.

Brief Biosketch:
Samuel Gan is Distinguished Research Professor at Wenzhou Kean University since 2022. Previously, he was the Senior Principal Investigator of his Antibody and Product Development Lab (APD) of A*STAR. He is also an adjunct Associate Professor of Psychology at James Cook University Singapore (JCUS). Gan's cross-disciplinary research interests include antibody engineering and virus drug resistance for sagacious drug design. He has been recognized as one of the "World's Most Promising Researchers" in the Interstellar Initiative by the New York Academy of Sciences and the Japan Agency for Medical Research and Development, as well as one of the 30 world class fusion innovators in the book "Innovation Through Fusion" by SP Jain School of Global Management. He is also the Bronze winner of the inaugural Merck Lab Connectivity Challenge 2020, and the 2021-22 "Science and Sustainability" category of the UK Alumni Awards, Singapore. In 2023, he is also a recipient of the Zhejiang province program of global experts, and also associate fellow of the British Psychological Society, UK. In 2024, he was awarded Senior Fellow of Advance HE (formerly, Higher Education Academy, UK).

Peerapat Thongnuek, Ph.D.
Assistant Professor
Biomedical Engineering Program, Faculty of Engineering, Chulalongkorn University, Bangkok, Thailand

Light-responsive nanoparticles for drug delivery

Abstract:

Utilizing light to control drug release enables precise spatio-temporal delivery, resulting in high drug concentrations at the target site and minimizing unwanted systemic effects, thereby enhancing treatment effectiveness and safety. In my presentation, I will demonstrate the use of a macrocyclic molecule, pillar[5]arene, in the formation of nanoparticles as our main drug delivery system. Pillar[5]arene can encapsulate drugs typically used for antibiotics or cancer chemotherapy via host-guest chemistry. My research team has integrated azobenzene into our delivery system to make it responsive to light. When exposed to UV light, azobenzene undergoes trans-cis isomerization, disrupting the metastable drug carrier. This photoisomerization is crucial for achieving light-responsive drug delivery in our system. We believe that this approach could be beneficial for treating various diseases, including cancer.

Brief Biosketch:

Peerapat Thongnuek was born in Phetchabun, Thailand. He is an assistant professor in the Biomedical Engineering Program at the Faculty of Engineering, Chulalongkorn University. Dr. Thongnuek is also the director of the Biomedical Devices for Revolutionary Integrative Systems Engineering Research Unit (BMD-RISE). Dr. Thongnuek received his Bachelor's degree in Biology with First Class Honours from Mahidol University, Thailand, in 2009. He then earned a Master's degree in Regenerative Medicine, receiving the departmental prize, from the University of Bath, UK, in 2011. In 2015, he obtained his PhD in Physiology, Development, and Neuroscience from the University of Cambridge, UK. With a background in biology, Dr. Thongnuek transitioned his research focus to the field of biomaterials, particularly emphasizing material molecular modification.

신광수/Kwangsoo Shin

조교수/ Assistant Professor

인하대학교 고분자공학과/ Department of Polymer Science & Engineering,

Inha University, Incheon, 22212, Republic of Korea

Investigating the Impact of Polymer Branching on Nano-Bio Interactions

Abstract:

Nanomaterials are in constant interaction with biological environments, with dynamic processes such as adsorption/desorption and molecular exchange on the nanoparticle surface influencing key functions like opsonization, phagocytic clearance, biodistribution, drug release, and therapeutic effectiveness. Therefore, managing nano-bio interactions by altering nanoparticle surface identity is vital for the success of nanoparticle-based therapies in nanomedicine. Hydrophilic polymers, particularly polyethylene glycol (PEG), have been employed for nanoparticle surface modification, leading to enhanced pharmacokinetic behavior and improved biodistribution.

In this presentation, we will explore the influence of polymer branching on nano-bio interactions, referencing a range of studies. First, we will compare linear and hyperbranched polyglycerol with PEG, focusing on their stealth capabilities and the generation of anti-PEG antibodies. Next, we will examine the application of bottle-brush PEG for nanoparticle surface grafting, suggesting that surface architecture can be a significant factor in increasing tumor accumulation in vivo and promoting cellular uptake in cancer cells. Finally, we will investigate the effect of branched polymer structures on mRNA delivery, using branched poly(amino-co-ester) (bPACE) as a case study, and comparing its performance with linear PACE and bPACE with varying levels of branching.

This presentation will provide a comprehensive overview of the potential of branched polymers in modulating nano-bio interactions, offering new insights for enhancing nanoparticle-mediated treatments in nanomedicine.

Brief Biosketch

Kwangsoo Shin is an Assistant Professor in the Department of Polymer Science and Engineering at Inha University. He has held this position since March 2023, after completing postdoctoral research in the Department of Biomedical Engineering at Yale University, under the supervision of W. Mark Saltzman (2019–2023). He also conducted postdoctoral research at the Center for Nanoparticle Research at the Institute of Basic Science, South Korea. Shin earned his Ph.D. in Engineering from the School of Chemical & Biological Engineering at Seoul National University in 2018, under the supervision of Prof. Taeghwan Hyeon.

Prof. Shin's research interests are focused on the design and application of nanomaterials for drug delivery, gene therapy, and tissue engineering. His work emphasizes the role of polymer branching in nano-bio interactions, enhancing drug and mRNA delivery, and improving pharmacokinetics. He has published over 40 peer-reviewed articles (h-index with 26), and has made significant contributions to the understanding of how nanoparticle surface modifications affect biological interactions and their modulation for biomedical application.

허윤석/Yun Suk Huh

교수/ Professor

인하대학교 생명공학과/ Department of Biological Engineering, Inha University
NanoBio High-Tech Materials Research Center
Inha University, Incheon, 22212, Republic of Korea

Generation and Control of Bioplasma-based Bioactive Species for the Development of Next-Generation Cancer Immunotherapy

Abstract:
Here, we fabricated various types of reactive oxygen (ROS) and nitrogen species (RNS) selectively through a newly designed bioplasma platform, which was the integration of double barrier dielectric plasma and droplet-based microfluidics. Through the new platform, ROS and RNS could qualitatively, quantitatively, and selectively be produced depending on the components inside the solution. Analyzed ROS including hydrogen peroxide (H_2O_2), hydroxyl radicals (•OH) and singlet molecular oxygen ($^1O_2$) showed the same phenomenon that the amount formed decreased as the components such as inorganic salt, vitamin, and amino acids were steadily included. Interestingly, RNS including nitric oxide (•NO), peroxynitrite ($ONOO^-$) and nitrite/nitrates (NO^{2-}/NO^{3-}) was only formed when amino acids were dissolved under the solution, indicating that RNS can selectively be formed by simply adding specific types of amino acids. Various plasma-activated solutions were further treated to colon cancers and analyzed the cell death signaling pathway. Plasma-activated solutions with ROS itself led the apopototic cell death while them with ROS and RNS led the immunogenic cell death, indicating that cells treated by ROS and RNS showed different pathway. Therefore, we believe that various reactive species can be selectively formed through the newly designed bioplasma platform, and by determining the cell death pathway of the generated reactive species, reactive species will be applied in future cancer treatment studies.

Brief Biosketch

Yun Suk Huh is a Professor in the Department of Biological Engineering at Inha University. He has been appointed as an IFP (Inha Fellow Professor) at Inha University since 2015. His PhD works included Bio-micro-electro-mechanical-systems (Bio-MEMS) experiment for the application in micro-TAS for the diagnosis of tumor. He also carried out postdoctoral research in David Erickson's lab at Cornell University (2007-2010), focusing on the fabrication of Opto-fluidic device for biomolecules detection. The main research interest of his laboratory is to develop i) the optical and electrochemical sensor for the highly sensitive detection of biomolecules and diseases. In addition, he is working on the synthesis of ii) biofunctional materials for drug delivery and therapy. His research work required the techniques of detection of biomolecules such as protein, DNA, chiral compounds, and organic acids, functionalization of organic/inorganic hybrid materials. He has published more than 420 SCI research articles to date, with an H-index of 70 according to Google Scholar.

IBEC5. Seoul National University

BK21 FOUR Future ICT Pioneers, GoGE/SDG Project Group for Education and Research in Medical AI / Global Data-X Leader HRD

Chair: Jongmo Seo Seoul National University, **Kyu Eun Lee** Seoul National University

November 7, 13:15 ~ 15:15, Main Building 2F White

Jiye Kim Seoul National University
Deep learning powered advanced susceptibility imaging at 7T

Hyoungjoon Kim Seoul National University
Review of a patient-pndependent approach to epilepsy detection with 0-shot training via seizure-clusterinception CNN (Sci-CNN)

Jong Hyeon Lee Seoul National University
The impact of healthcare workers' movements on the spread of air-borne infection factors

Zihuan Wang China Eye Valley, Wenzhou, China
AI healthcare in China

Zoltán Gáspári Pázmány Péter Katolikus Egyetem, Budapest, Hungary
Protein structure models in the AI era: where do experiments and dynamics fit in?

György Cserey Pázmány Péter Katolikus Egyetem, Budapest, Hungary
Spatial sensor-based augmented reality

Jisung Kim Seoul National University Hospital
Recent advancement of flexible MEMS-based neural interface

Deep learning-powered advanced susceptibility imaging at 7T

Jiye Kim[1], Jongho Lee[1]*

[1] Department of Electrical and Computer Engineering, Seoul National University, Seoul, Korea

*E-mail: jonghoyi@snu.ac.kr

A recently developed quantitative susceptibility mapping (QSM) technique, called χseparation[1], enables the separation of paramagnetic (χ_{para}) and diamagnetic (χ_{dia}) susceptibility distributions in the brain. This approach facilitates *in-vivo*, high-resolution mapping of iron and myelin distributions, which could significantly improve our understanding of brain substructures and their functions. Utilizing 7T MRI, with its superior signal-to-noise ratio and enhanced susceptibility effects, further benefits this process. However, implementing χ-separation at 7T poses challenges, including needing an R2 map, high specific absorption rate (SAR), B1 transmit field inhomogeneities, and longer scan times. To address these issues, we developed $R2PRIMEnet_{7T}$, a deep neural network that converts a 7T R2* map into a 3T R2′ map. Building on this, we introduce a new 7T χ-separation pipeline that generates highresolution maps from multi-echo gradient-echo data[2]. Compared to other approaches, such as an end-to-end network and linearly-scaled R_2', the proposed method showed more accurate χ-separation maps with contrasts similar to 3T and greater detail in high-resolution maps. This technique offers promise for studying neurodegenerative diseases by precisely mapping iron and myelin concentrations in brain structures (IRB No. 1805/003-011).

Acknowledgement: This work was supported by the National Research Foundation of Korea (NRF) (NRF-2022R1A4A1030579 and RS-2024-00349509) and the Institute of New Media and Communications (INMC), SNU.

References

[1] Shin, H.-G. et al. *NeuroImage* 240, 118371 (2021)
[2] Kim, M. et al. *arXiv* (2024)

Keywords: high-field MRI, quantitative susceptibility mapping, deep learning, susceptibility source separation

This paper was presented at the IBEC 2024 session 5, hosted by Seoul National University BK21 Future ICT Pioneers, GoGE/SDG, Project Group for Education & Research in Medical AI and Global Data-X Leader HR.

The Impact of Healthcare Workers' Movements on the Spread of Air-borne Infection Factors

Jong Hyeon Lee[1, 2], Min Hyuk Lim[3], Sungwan Kim[4], Changhoon Baek[2*]

[1]Interdisciplinary Program in Bioengineering, Seoul National University, Korea
[2]Department of Transdisciplinary Medicine, Seoul National University Hospital, Korea
[3]Graduate School of Health Science and Technology, UNIST, Korea
[4]Department of Biomedical Engineering, Seoul National University College of Medicine, Korea

[*]E-mail: chbaek@snu.ac.kr

The COVID-19, which emerged in 2019, is characterized by rapid transmission and a high mortality rate. The rapidly increasing number of patients led to a lack of space in the hospital, and prior studies were conducted to propose a patient isolation unit (PIU) that provide physical isolation and airflow control for each patient [1, 2]. In real situations, movement of healthcare workers are expected to influence the spread of the virus. Thus, this study aimed to analyze the impact of healthcare workers' movements on the spread of the virus. This study was conducted through computational fluid dynamics simulation based on Ansys Fluent 2022 R2 software, and it was assumed that airborne virus infected patient was breathing while staying in a PIU. Then, the droplet dispersion was compared between the cases when an object imitating a healthcare worker was absent and when it was moving.

Simulation results showed that the droplets spread more rapidly throughout the airflow space when a moving object was present. Additionally, droplets were detected more quickly and in higher concentrations outside of the PIU. These results indicate that the movement of healthcare workers significantly affects droplet dispersion. Based on the results of this study, future research will be able to determine how not only the simple movements of healthcare workers but also various medical procedures affect the spread of airborne infection factors.

Acknowledgement: This research was supported by a grant of the project for Infectious Disease Medical Safety, funded by the Ministry of Health & Welfare, Republic of Korea (grant number : HG22C0020), and by grant no. 19-2023-0020 from the SNUH Research Fund.

References

[1] Saw, L. H. et al. *Environmental Science and Pollution Research* 28(38),53478-53492 (2021).
[2] Lee, J.H. et al. *Computers in Biology and Medicine* 173, 108309 (2024).

Keywords: COVID-19, Airborne virus, Patient isolation unit, Computational fluid dynamics

This paper was presented at the IBEC 2024 session 5, hosted by Seoul National University BK21 Future ICT Pioneers, GoGE/SDG, Project Group for Education & Research in Medical AI and Global Data-X Leader HR.

Review of a Patient-Independent Approach to Epilepsy Detection with 0-shot Training via Seizure-Cluster-Inception CNN (Sci-CNN)

Hyoungjoon Kim[1], Chne-Wuen Tsai[2,3], Rucheng Jiang[2], Lian Zhang[2,4], Miaolin Zhang[2], Junbeom Park[1], and Jerald Yoo[1*]

[1]Department of Electrical and Computer Engineering, Seoul National University, Korea
[2]National University of Singapore, Singapore, Singapore
[3]The N.1 Institute for Health, Singapore, Singapore, [4]Apple, Cupertino, CA

*E-mail: jerald@snu.ac.kr

Epilepsy is a chronic disorder characterized by uncontrollable, recurrent seizures caused by abnormal electrical discharges in the brain's neurons. Electroencephalogram (EEG) is commonly used to measure such epileptic events, with various types of machine-learning (ML)-based back-end classifiers to process detected electrical activity. However, inter-patient variations in seizure patterns have led many previous works to focus on patient-specific classifications, requiring repeated hospitalization and costly data collection. Furthermore, traditional ML-based classifiers require complex feature extractions, which may be suboptimal on System-on-Chip (SoC)s with constrained battery life and chip area [1]. The Seizure-Cluster-Inception Convolutional Neural Network (Sci-CNN) Neural Processor (SNP) [2] addresses such issues with a patient-independent seizure-tracking architecture trained with pre-existing databases, directly deployable to patients and progressively modified for better accuracy with zero-shot retraining.
Notably, this work utilizes the concept of a kernel-wise pipeline, which exploits repeated usage of same addresses in sequential feature maps to avoid redundant calls to memory. Also introduced is Neural Pattern Clustering, which extracts neural pattern distributions, as a final layer to label different pattern clusters. Overall, Sci-CNN succeeds in reducing both computations and SRAM size necessary for epilepsy detection of a higher precision.

Acknowledgment: This work was supported by the BK21 FOUR program of the Education and Research Program for Future ICT Pioneers, Seoul National University in 2024.

References (Maximum 2 References)

[1] L. Zhang *et al.*, "Review of AI-on-the-Edge EEG-Based Patient-Specific Epilepsy Tracking SoCs," *2022 20th IEEE Interregional NEWCAS Conference (NEWCAS)*, pp. 384-388, 2022
[2] C. -W. Tsai *et al.*, "Seizure-Cluster-Inception CNN (SciCNN): A Patient-Independent Epilepsy Tracking SoC With 0-Shot-Retraining," *IEEE Trans. Biomed. Circ. Sys. (TBioCAS),* vol. 17, no. 6, pp. 1202-1213, Dec. 2023.

Keywords: Inter-patient, kernel-wise pipeline, neural processor, patient-independent, seizure detection, zero-shot retraining

This paper was presented at the IBEC 2024 session 5, hosted by Seoul National University BK21 Future ICT Pioneers, GoGE/SDG, Project Group for Education & Research in Medical AI and Global Data-X Leader HR.

Zihuan Wang
Senior Scientist

China Eye Valley, Wenzhou, China
Engineering Research Institute, Seoul National University, Seoul, Korea.

AI Healthcare in China

Abstract:
Artificial Intelligence (AI) is transforming healthcare worldwide, and China is at the forefront of this transformation. With a rapidly aging population and increasing demand for healthcare services, China is leveraging AI to tackle multiple challenges in the healthcare sector, from improving diagnostic accuracy to optimizing hospital operations. Key areas of focus include AI-driven diagnostics, personalized medicine, telemedicine, and AI-assisted drug development. Additionally, we will discuss the regulatory frameworks shaping the development of AI in China's healthcare system and the ethical and data privacy issues arising in this fast-evolving field. The talk will also explore how China's unique healthcare infrastructure and vast data resources support AI applications, as well as the exploration of various avenues to foster international collaboration. As China continues to invest heavily in AI technologies, the country is expected to play a pivotal role in setting global healthcare standards, driving technological progress, and influencing policy changes.
Moreover, China is gradually shifting its focus to how new technologies can be applied in industry, and how academic results can be translated from the laboratory to the marketplace, bringing AI-driven products into households and benefiting the general population.

Brief Biosketch
Dr. Zihuan Wang earned his BS, MS, and PhD in Electrical and Computer Engineering from Seoul National University, completing his doctorate in 2023. Since 2024, he has been a senior scientist at China Eye Valley and a visiting researcher at Seoul National University. His research focuses on AR/VR applications, including spatial sensor-based augmented reality for disaster management and precision surgical navigation. Dr. Wang's expertise spans computer-aided surgery, HMD devices, and retinal image processing.

This lecture was given at the IBEC 2024 session 5, hosted by Seoul National University BK21 Future ICT Pioneers, GoGE/SDG, Project Group for Education & Research in Medical AI and Global Data-X Leader HR.

Zoltán Gáspári
Professor

Pázmány Péter Catholic University, Faculty of Information technology and Bionics

Protein structure models in the AI era: where do experiments and dynamics fit in?

Abstract:
Understanding protein structure is inevitable for modern medical and biotechnological applications. Traditionally, structural information was relatively scarce compared to sequences because of the efforts required for experimental structure determination. Although several experimental steps could be effectively scaled up, the real breakthrough in the availability of structural data arrived with the development of AlphaFold, an AI-based structure prediction approach. On the other hand, the design of proteins with desired structure and function has become a reality, also largely due to the development of computational methods in the field of structural bioinformatics. Although both these aspects provide a giant leap in the field, there are still many aspects to be solved, including the integration of experimental data and the representation of the internal motions of proteins, the latter of which is intimately linked to the mechanistic aspects of protein function. In my lecture, I will overview the current status of the field and will also provide case studies that emphasize the importance of integrating computational methods with experimental data.

Brief Biosketch
Dr. Zoltán Gáspári is a full professor at Pázmány Péter Catholic University, Hungary, specializing in the structure and dynamics of postsynaptic proteins. He earned his Ph.D. in Structural Biochemistry from Eötvös Loránd University in 2004. With over 60 publications and 2,000 citations, he is also the editor of “Structural Bioinformatics” in the “Methods in Molecular Biology” series. Dr. Gáspári leads the Bioinformatics MSc program and teaches courses on structural bioinformatics, chemical biology, and molecular genetics.

This lecture was given at the IBEC 2024 session 5, hosted by Seoul National University BK21 Future ICT Pioneers, GoGE/SDG, Project Group for Education & Research in Medical AI and Global Data-X Leader HR.

György Cserey
Professor
Dean

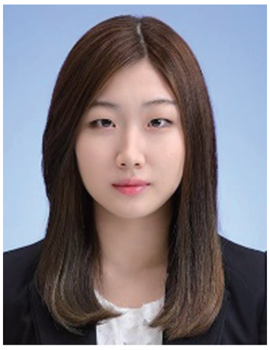
Pázmány Péter Catholic University, Faculty of Information technology and Bionics

Spatial sensor-based augmented reality

Abstract:
The project, inspired by the sinking of the cruise ship Hableány in the Danube, aims to develop a system to simplify the location and rescue of disaster victims under challenging conditions. Traditional methods utilize sonar to map underwater terrains, but divers must rely on memory to navigate in low-visibility waters, making rescues dangerous and slow. The proposed solution leverages virtual reality (VR) and augmented reality (AR) technologies to provide divers with continuous, real-time visual information that aligns with their current orientation. By accurately matching virtual 3D maps to the actual underwater environment, divers can perceive virtual objects as if they were real, enhancing navigation even in zero-visibility conditions. Advancements in machine learning and artificial intelligence enable the transformation of sonar data into photorealistic images without the need for conventional cameras. By training neural networks with matched camera and sonar images in clear water conditions, the system can later generate visual scenes from sonar data alone in murky environments. This approach aims to make rescue operations safer and more efficient by providing divers with an accurate and responsive visual representation of their surroundings.

Brief Biosketch
Dr. György Cserey obtained his MSc from the Budapest University of Technology and Economics in 2003. He received his PhD in info-bionics from the Faculty of Information Technology and Bionics at Pázmány Péter Catholic University (PPKE) in 2006. He has been working at PPKE's Faculty of Information Technology and Bionics since 2006, initially as an Assistant Professor and later as an Associate Professor. Dr. Cserey became the Dean of the faculty, after serving as Vice Dean from 2018 to 2024. His research focuses on sensory robotics, parallel computing, machine learning, and neuro-bio-inspired systems. He has led the robotics laboratory at PPKE and has been involved in developing sensors, circuits, and robots.

This lecture was given at the IBEC 2024 session 5, hosted by Seoul National University BK21 Future ICT Pioneers, GoGE/SDG, Project Group for Education & Research in Medical AI and Global Data-X Leader HR.



Jisung Kim
PostDoc
Junior Scientist

Department of Transdisciplinary Medicine, Seoul National University Hospital

Recent Advancement of Flexible MEMS-based neural interface

Abstract:
This talk explores recent advancements in flexible MEMS-based neural interfaces, focusing on applications in artificial vision systems, including epiretinal and subretinal prostheses, as well as visual cortex stimulation. Epiretinal devices, such as the Argus II, use flexible polyimide electrodes to stimulate retinal ganglion cells, providing basic visual perception, though challenges in long-term stability and electrode positioning remain. Subretinal systems, like Alpha IMS, place flexible electrodes closer to the photoreceptors for more direct stimulation, but involve more complex surgical procedures.
In addition, flexible MEMS-based electrodes are being used in visual cortex stimulation devices, such as ORION, which bypass the retina and directly stimulate the brain for patients with severe visual impairments. Recent innovations in flexible materials and 3D-structured MEMS electrodes have improved device durability, precision, and resolution, while reducing surgical risks. These advancements position flexible MEMS-based neural interfaces as a key technology for future enhancements in both performance and patient outcomes in neuroprosthetic applications.

Brief Biosketch
Jisung Kim received the B.A. degree in electrical engineering in Ajou university, Suwon, South Korea. She got her M.S.-Ph.D conjoined degree in biomedical engrineering from Seoul National University(SNU), Seoul, South Korea in 2023. From 2018 to 2020, she was with University of Padova, Padua, Italy as a visiting Ph.D student, working in wireless power and data delievery system for implantable medical devices. From 2023 to 2024, she was with Sydney University, Sydney, Austrailia as a post-doctoral researcher and she has been working as a post-doctoral researcher in the Department of Transdisciplinary Medicine at Seoul National University Hospital, Korea since 2024. Her reseach activities are devoted to the development of biocompatible invasive electrode for artificial retina and wireless power & data transfer system for neuro stimulation.

This lecture was given at the IBEC 2024 session 5, hosted by Seoul National University BK21 Future ICT Pioneers, GoGE/SDG, Project Group for Education & Research in Medical AI and Global Data-X Leader HR.

www.koamex.co.kr

동시 개최 | MEDI EXPO KOREA 2025 메디엑스포 코리아

KOAMEX 2025

Korea International Advanced Medical Equipment & Medicine Expo

대한민국 국제 첨단 의료기기 및 의료 산업전

6. 20 금 - 6. 22 일 EXCO

공동주최 | DAEGU | 대구광역시 DAEGU METROPOLITAN CITY KMEDIhub

주 관 | KMEDIhub EXCO

HYUNDAEM MEDITECH

기업개요

업종	의료기기 제조업
소재지	강원특별자치도 원주시 지정면 청정로 80
자본금	5억원
2023 매출액	10,043,489 천원
2023 수출액	4,571,920 $
직원수	48 명

기업연혁

연도	업종
2012	법인전환 (주식회사 현대메디텍)
2013	봉합사 CE 인증 획득
2015	이노비즈 인증 획득
2017	100만불 수출의탑 달성
2018	본사 확장 이전(원주 기업도시)
2020	강원스타기업 지정
2021	수출유망중소기업 지정
2022	글로벌강소기업 지정 MDSAP 인증 획득 300만불 수출의탑 달성
2023	글로벌강소기업 1000선정 500만불 수출의탑 달성

주력제품

제품구분	PDO 봉합사	화장품		
제품명	시크릿라인	이루아솔루션	EXODEW	인텐시브 피토크림
이미지				
제품구분	필러			
제품명	DIOSHA	FLOSHA	REVLUM PLLA	DIOSHAINE PN
이미지				

강원특별자치도 원주시 지정면 청정로 80 현대메디텍
support@hyundaemed.co.kr
033.734.3061

2025학년도 전기 일반대학원 신입생 모집

의료기기산업학과

국내 1호 의료기기산업 특성화대학원 동국대학교 의료기기산업학과는 한국보건산업진흥원의 지원을 받아 산업계 수요 맞춤형 교육 커리큘럼을 운영하여 실무 중심의 융합형 인재를 양성하고 있습니다.

"의료기기 인허가 및 품질 관리 전문가,
의료기기 제품 기획 및 마케팅 전문가"

실무 교육 커리큘럼

- 의료기기 산업 맞춤형 전문 교육과정 운영

- 의료기기 전주기 교육 커리큘럼 운영
- 산업현장에 적용 가능한 이론 및 실습 교육
- 의료기기 규제과학(RA)전문가 교육 프로그램 운영
- 최신 의료기기 산업 동향 세미나/심포지움 개최

장학금 지원

- 전일제 수업료 100% 지원
- 부분제 수업료 25% 지원
  (신입생 전원지급, 재학생 직전학기 성적에 근거하여 지급)

취업 지원

- 채용 조건형 인턴십 프로그램 운영
- 취업률 100% (2023년 12월 기준)

학생 활동 지원

- 국내 유수 기업 및 기관 인턴십 프로그램 운영
- 해외 장기 인턴십 지원 (싱가포르, 일본 등)
- 소속 연구실별 산학협력 프로젝트 기반 인건비 지급
- 학술대회 발표 및 논문 게재 등 연구활동 지원

모집과정

- 석사 과정 00명
- 박사 과정 00명
- 석·박사 통합 과정 00명

모집일정

- **인터넷 접수 :** 24.11.01(금) ~ 11.08(금)
- **서류제출 :** 24.11.01(금) ~ 11.11(월)
- **면접심사 :** 24.11.23(토)
- **합격자 발표 :** 24.12.09(월)

* 자세한 내용은 본교 일반대학원 홈페이지 참조 (https://gs.dongguk.edu/)

지원자격

- 학사학위 취득자 또는 예정자
  (모든전공 연계 지원 가능)

문 의

- Tel: 02-2290-1449
- E-mail: dmed@dongguk.edu

홈페이지 바로가기

학과 홍보 동영상 바로보기

동국대학교 dongguk university

사람투자

2025학년도 전기 일반대학원 신입생 모집

동국대학교 바이오헬스의료기기규제과학과는 인공지능, 빅데이터, 융·복합 기술과 같은 새로운 기술 기반 제품의 안전성/유효성 등을 평가할 수 있는 "규제 과학 연구 인력"을 양성합니다.

바이오헬스의료기기 규제과학과

"규제과학(Regulatory Science)"이란 ?
규제가 필요한 제품의 안전성, 유효성, 품질, 성능등의 평가부터 허가·사용까지 규제적 의사결정에 활용되는 모든 도구, 기준 및 접근방법 등을 개발하는 과학

바이오헬스의료기기규제과학과는 "의료기기규제과학과"의 새로운 명칭으로 2023년 9월부터 사용되는 명칭입니다.

첨단 융복합 과학기술 전문가

AI/ML 및 모델링 시뮬레이션 기반 첨단 융복합 의료기기 평가 기술 역량 보유한 규제전문가 양성

임상 데이터 사이언스 전문가

데이터 사이언스 기반 임상시험 혁신 및 근거중심 의사결정 역량을 보유한 규제과학 전문가 양성

2025 전기 일반전형

원서접수_
24. 11.01(금) ~ 11.08(금)

장학금 지원

- 첫 학기 수업료 100% 장학 + 인건비 150만원 / 월 (전일제)
- 수업료 25% 장학 (부분제)

인턴쉽 지원

- 국내 : 식품의약품안전처, C&R 리서치, 한랩, 솔메딕스, 휴톰, 사이넥스 등
- 해외 : 싱가포르, 일본, 미국 등 해외 기업 및 유수 연구 기관

입시일정

인터넷 접수	24.11.01(금) ~ 11.08(금)
서류 제출	24.11.01(금) ~ 11.11(월)
면접 심사	24.11.23(토)
합격자 발표	24.12.09(월)

모집과정

석사과정 / 박사과정 / 석·박사통합과정 00명

지원자격

학사학위 취득자 또는 예정자(모든 전공 연계 가능)
이학/공학 계열 및 의공학과 졸업자/졸업 예정자 우대

홈페이지 바로가기
학과홍보 동영상 바로가기

식품의약품안전처 dongguk UNIVERSITY

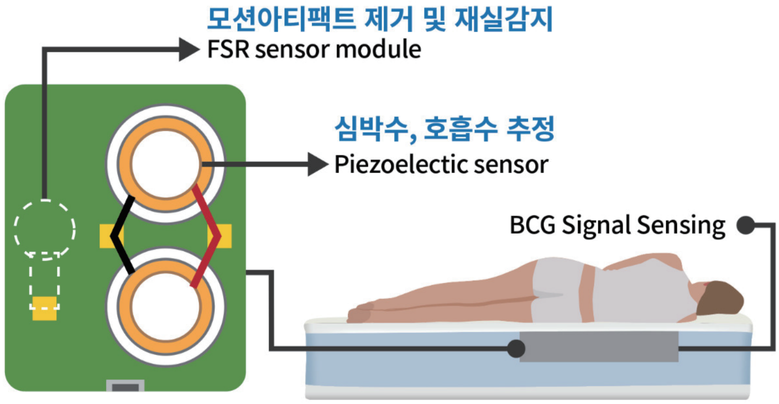
Tel. 02-2290-1449 Email. rsmed@dongguk.edu Homepage. http://rsmed.dongguk.edu/

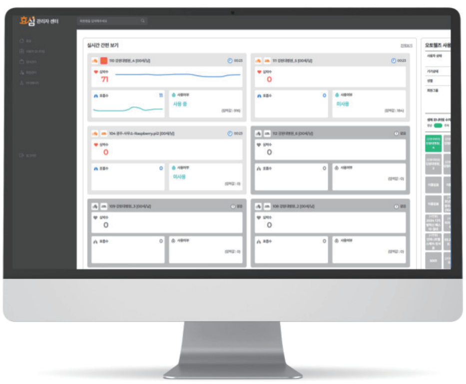
주식회사 오토웰즈

사람을, 건강을 생각하는, SingleCARE

BCG(심탄도) 압전센서 기반 무구속 무자각 방식

사용자는 신체에 어떠한 센서도 부착할 필요 없이 편안하게 건강 상태를 모니터링할 수 있습니다.



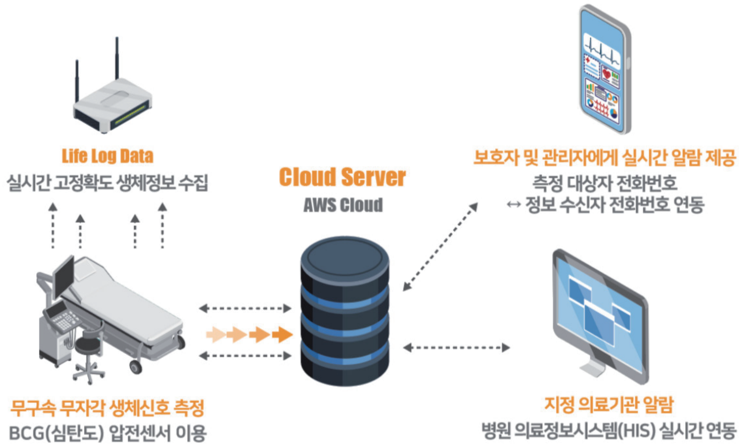


실시간 원격 다중 건강 모니터링

심박수, 심박변이도, 호흡수, 수면무호흡, 스트레스 지수 등의 주요 생체 신호를 실시간으로 측정하여 종합적인 건강 상태를 관리합니다.

AWS 클라우드 컴퓨팅 서비스

언제 어디서나 스마트폰 또는 PC를 통해 생체 신호 데이터를 확인하고 관리할 수 있어, 비대면으로도 안전한 케어가 가능합니다.



인증 획득으로 제품 안정성 확보

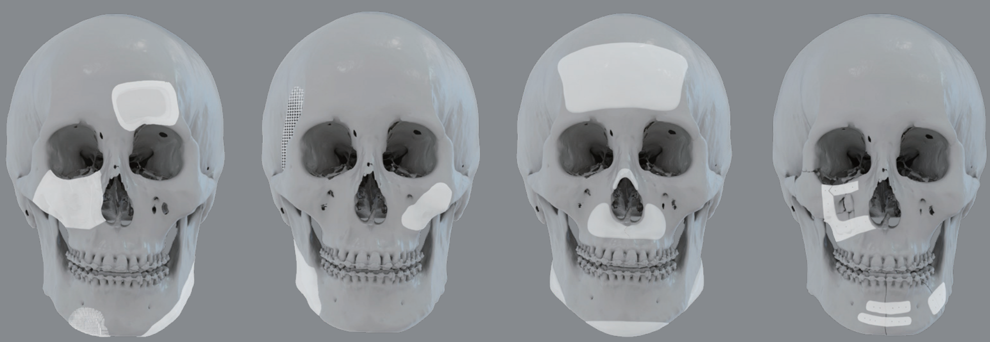
ISO9001 KC CE RoHS

Internal use only

EASYMADE CF

Craniofacial Patient-Specific Implant

Bio-Active Ceramic 3D Printing Medical Device



CGBIO
CELL & GROWTH FACTOR
BIOTECHNOLOGY

CGBIO Co., Ltd. 211, Itaewon-ro, Yongsan-gu, Seoul, Korea
Tel. +82-2-550-8300 www.cgbio.co.kr

IEC 62366-1:2020

의료기기사용적합성

KOLAS 공인시험기관

사용적합성평가란?
환자, 사용자의 의료기기 사용 관련 안전을 제공하기 위해 유효성, 효율성 및 사용자 만족도를 확립하는 과정으로 2022년 이후 의료기기 인허가 등록 절차 중 의료기기 적합성평가가 의무화됨에 따라 그 중요성이 점점 대두되고 있습니다.

사용적합성평가의 솔루션! 계명대학교 사용성평가연구센터만의 특징

빠른 평가결과서

- 기업별 맞춤형 평가시험
- 니즈 파악으로 시간 절약
- 정부과제 성과검증 평가서

전문의료진 기반 평가

- 10여개 진료과 의료진
- 의료기기 전문 평가시험
- 휴먼팩터기반 평가실시

의료기기 인허가 및 디자인 컨설팅 제공

- 의료기기 인허가 연계
- 의료기기 디자인 분석
- 디자인 컨설팅 제공

CATT 사용성평가연구센터

대구광역시 달서구 달구벌대로 1095
계명대학교 사용성평가연구센터

www.catt.center

평가문의 053.580.8980

리콜코리아	재단법인 오송첨단의료산업진흥재단
연세대학교	산업부 병원-기업협력사업
(주)두리시스템테크놀로지	주식회사 지브레인
동국대학교 의료기기산업학과	김해의생명산업진흥원
계명대학교 사용성평가연구센터	(주)제윤
주식회사 뉴퐁	스피나시스템즈(주)
주식회사 레오헬스케어	엘티바이오(주)
주식회사 인벨류비즈	(주)위무브
BMEL	대구경북첨단의료산업진흥재단
(주)엠큐브테크놀로지	엣지케어
(주)싸이웰에스엔비	재활공학연구소
연세대학교 미래캠퍼스 의료AI반도체전문인력양성사업단	한국과학기술젠더혁신센터
주식회사 밀 알	(주)현대메디텍
(재)원주의료기기테크노밸리	시지바이오
한국의료기기안전정보원	주식회사 오토웰즈
한국의료기기협동조합	식품의약품안전처
우영메디칼	사단법인 한국의료기기산업협회
대한병원협회	대성마리프