6th International Bio-Medical Interface Symposium 2025

IBMI 2025

March 8th-9th, 2025

Shuang Ho Campus of Taipei Medical University (TMU)
No. 301, Yuantong Rd, Zhonghe District, New Taipei City, Taiwan 235

Symposium Chairs
Prof. Kohei SOGA, Tokyo University of Science, Japan
Prof. Tsung-Rong KUO, Taipei Medical University, Taiwan

PROGRAM AT A GLANCE

Day 1 Sat. March 8th, 2025
9:00-9:20 ***OPENING REMARKS***
Day 1 Sat. March 8th, 2025
9:20-10:50 ***Session A. Materials & Pharmaceutics***
Chairs: Prof. Masao KAMIMURA (TUS) / Prof. Jen-Chang YANG (TMU)
Day 1 Sat. March 8th, 2025
11:05-12:35 ***Session B. Device & Robotics***
Chairs: Prof. Hiroshi TAKEMURA (TUS) / Prof. Bing-Shiang YANG (NYCU/ITRI)
Day 1 Sat. March 8th, 2025
14:05-15:45 ***Session C. Special***
Chairs: Prof. Hiroaki HOBARA (TUS) / Prof. Cheng-Yu TSAI (TMU)
Day 1 Sat. March 8th, 2025
16:00-17:15 ***Session D. Photonics & Imaging***
Chairs: Prof. Kohei SOGA (TUS) / Prof. Tsung-Rong KUO (TMU)
Day 2 Sun. March 9th, 2025
10:00-11:15 ***Session E. Medicals***
Chairs: Prof. Hidehiro KISHIMOTO (U. Ryukus) / Prof. Jiunn-Horng KANG (TMU)
Day 2 Sun. March 9th, 2025
11:15-11:30 ***CLOSING REMARKS***

PROGRAM DETAILS

VENUE

Room# 9701, 7th Floor, Biomedical Technology Building

Shuang Ho Campus of Taipei Medical University (TMU)

No. 301, Yuantong Rd, Zhonghe District, New Taipei City, Taiwan 235

235 新北市中和區圓通路 301 號

BANQUET PLACE

18:00(maybe. not dcided yet) Day 1 Sat. March 8th, 2025

状元楼晶豪宴会館　喬福大楼 3 楼 (3rd floor)

https://maps.app.goo.gl/56ze5qu5jnCpWdem8

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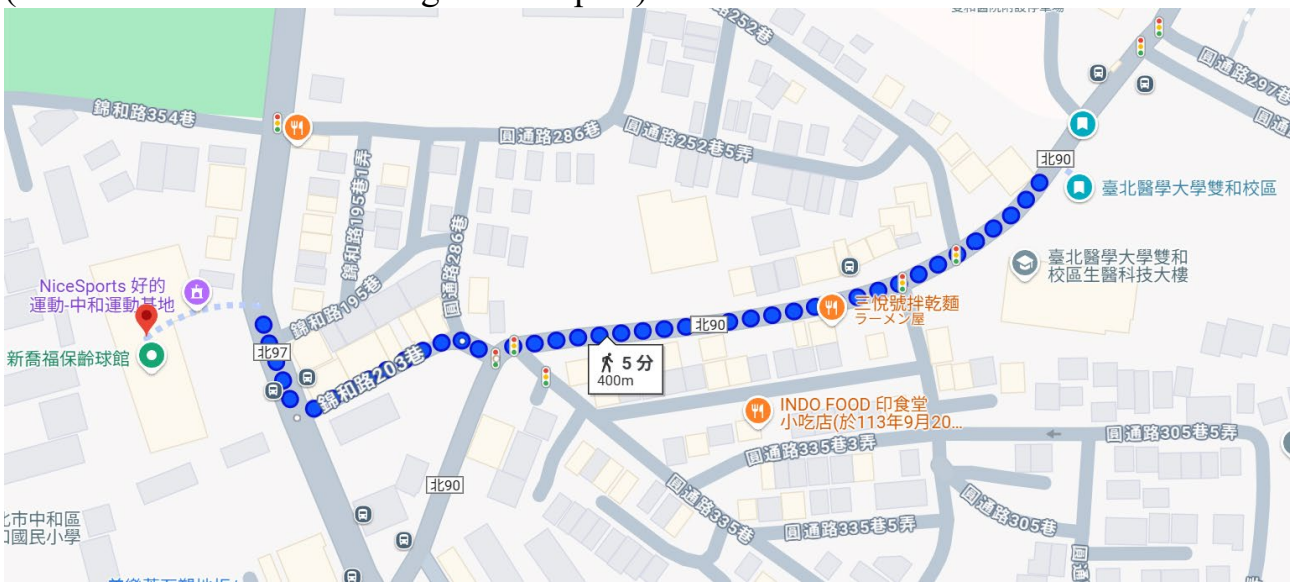
(5 min. walk from the Huang Ho Campus.)



Day 1 Sat. March 8th, 2025

9:20-10:50

Session A. Materials & Pharmaceutics

Chairs:

Prof. Masao KAMIMURA (TUS) /

Prof. Jen-Chang YANG (TMU)

Nanoparticles-Based Polymer Materials for Mechanobiology

Masao KAMIMURA[1)]

[1)] Department of Medical and Robotic Engineering Design, Faculty of Advanced Engineering,
Tokyo University of Science

Mechanobiology is the force-related study of cells and has attracted much attention. Today, various biomaterials for cell culture scaffolds have been developed and also used for mechanobiological studies, such as stiffness-controlled hydrogel substrates for cell culture. On the other hand, our group has been working on nanoparticle-based biomaterials such as drug delivery carriers, imaging probes, or cell manipulation tools. Because nanoparticles can be loaded with various functions, these materials are also expected to be a powerful tool in cell mechanobiology research. Although many researchers have also reported on nanoparticle biomaterials, applying nanoparticles for mechanobiology is still a challenge. Therefore, our group focuses on the application of nanoparticle-based polymer materials for mechanobiology research.

Mechanical properties-controlled hydrogels are a typical application of polymer biomaterials for mechanobiological studies. It is well known that cells exhibit scaffold mechanical properties-dependent adhesion and various functional changes. Therefore, many researchers have reported the development of external stimuli such as pH or light-responsive tuning of mechanical properties of gel materials and their application for mechanobiology. However, most current external stimuli techniques cause damage to cells, and thus, safety stimuli-responsive materials are required for cell mechanobiology studies. Therefore, our group has recently developed a magnetic nanoparticle cross-linked hydrogel substrate for mechanobiological studies. The designed hydrogel exhibits magnetic field-responsive changes in mechanical properties. We have used this material for various mechanobiological studies such as cell migration studies, differentiation of myoblasts, or T-cell activation.

Another unique feature of nanoparticle-based mechanobiology is the targeted mechanical stimulation of local regions in cells, such as membrane proteins or organelles. For example, targeted mechanical stimulation of mechano-sensitive ion channels on the cell membrane, such as Piezo or TRPV channels, is successfully performed, and Ca^{2+} influx into the cells is controlled by polymer-modified nanoparticles and magnetic stimulation. A small amount of Ca^{2+} influx causes activation of neurons or cardiomyocytes. On the other hand, excessive Ca^{2+} influx can also be induced by the same technique and it causes cancer cell death.

In this presentation, the author will present recent advances in our nanoparticle-based polymer materials for application in mechanobiology studies.

Curriculum Vitae

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EDUCATION
2007 B. Tech., Materials Science, Tokyo University of Science, Japan
2009 M. Tech., Materials Science, University of Tsukuba, Japan
2012 Ph.D, Materials Science, University of Tsukuba, Japan (Supervisor: Prof. Yukio Nagasaki)

PROFESSIONAL EXPERIENCE
2012-2013 Postdoctoral Research Associate, University of Nebraska Medical Center, US.
2013-2014 MANA Research Associate, National Institute for Materials Science (NIMS), Japan.
2014-2018 Assistant Professor, Tokyo University of Science, Japan.
2018-2022 Junior Associate Professor, Tokyo University of Science, Japan
2022-present Associate Professor, Tokyo University of Science, Japan

RESEARCH TOPICS
Biomaterials, Cell Manipulation, Mechanobiology, Biological Phase Separation

SELECTED RECENT PUBLICATIONS
S. Yamamoto, C. Chang, M. Kamimura, J. Nakanishi
"Exploring anti-cancer activities of epidermal growth factor-immobilized polymeric nanoparticles"
Science and Technology of Advanced Materials (2025) DOI: 10.1080/14686996.2025.2463316

T. Ueki, Y. Osaka, K. Homma, S. Yamamoto, A. Saruwatari, H. Wang, M. Kamimura, J. Nakanishi
"Reversible Solubility Switching of a Polymer Triggered by Visible-Light Responsive Azobenzene Photochromism with Negligible Thermal Relaxation"
Macromolecular Rapid Communications 45 (2024) 2400419.

K. Kojima, S. Tomita, M. Kamimura
"Fluorescence Imaging of Nanoparticle Uptake into Liquid-Liquid Phase-Separated Droplets"
ChemPlusChem 88 (2023) e202300207.

S. Sakakibara, S. Abdellatef, S. Yamamoto, M. Kamimura, J. Nakanishi
"Photoactivatable surfaces resolve the impact of gravity vector on collective cell migratory characteristics"
Science and Technology of Advanced Materials 24 (2023) 2206525.

W. Chen, T. Onoe, M. Kamimura
"Noninvasive Near-Infrared Light Triggers the Remote Activation of Thermo-Responsive TRPV1 Channels in Neurons Based on Biodegradable/Photothermal Polymer Micelles"
Nanoscale 14 (2022) 2210-2220.

Advancing Cancer Therapy with Silica Nanoparticle-Based Nanomedicine

Si-Han Wu[1] and Yi-Ping Chen[1]

[1]Graduate Institute of Nanomedicine and Medical Engineering, Taipei Medical University, Taiwan

Abstract

Mesoporous silica nanoparticles (MSNs) are promising nanocarriers for cancer therapy, yet efficient blood-brain barrier (BBB) penetration and metastasis suppression remain significant challenges. Here, we present ligand-free PEGylated MSNs (MSN-PEG-TA), designed to enhance circulation, BBB permeability, and antimetastatic activity. This 25 nm nanoparticle, functionalized with polyethylene glycol (PEG) for stability and quaternary amine (trimethylammonium, TA) molecules for a slight positive charge, facilitates superior tumor accumulation via the enhanced permeability and retention (EPR) effect. MSN-PEG-TA demonstrates intrinsic antimetastatic properties by reducing lung metastases in 4T1 xenograft models and inhibiting cancer cell migration and endothelial tube formation through ERK, FAK, and paxillin pathway modulation. Notably, its combination with liposomal doxorubicin (Lipo-Dox) significantly improves survival outcomes, surpassing Lipo-Dox monotherapy.

Moreover, MSN-PEG-TA demonstrates superior BBB penetration by interacting with apolipoprotein E and albumin, key mediators of BBB transcytosis. Doxorubicin-loaded MSN-PEG-TA (DOX@MSN-PEG-TA) achieves a sixfold increase in brain accumulation, effectively suppressing glioma growth and extending survival by over 28% in spontaneous brain tumor models compared to free DOX. Additionally, octyl group-modified MSN-PEG-TA (C8-MSN) successfully deliver docetaxel (DTX) across the blood-brain tumor barrier (BBTB), overcoming temozolomide resistance and improving survival in glioblastoma models.

These findings establish MSN-PEG-TA as a versatile nanoplatform for targeted drug delivery, BBB penetration, and metastasis suppression, paving the way for next-generation cancer nanomedicine.

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Biography:

Dr. Yi-Ping Chen received his Ph.D. in Chemical Biology from National Taiwan University in 2013 and then conducted postdoctoral research at the Research Center for Applied Sciences, Academia Sinica, Taiwan, from 2013 to 2015. In 2015, he joined Taipei Medical University as an assistant professor. His research focuses on designing multifunctional mesoporous silica nanoparticles (MSNs) with high translational potential by optimizing stealth coatings, charge modulation, size, and surface functionalization. These enhancements improve biocompatibility, biodegradability, immune evasion, circulation time, tumor targeting, and biological barrier penetration. Dr. Chen's research group explores nanoscale therapeutic strategies using silica nanoparticle-based approaches for the intracellular delivery of proteins, enzymes, antibodies, small-molecule drugs, and nucleic acid-based therapies to tackle challenging human diseases. His work integrates nanomedicine with immunotherapy, neurotherapy, cancer therapy, and protein therapy, with a strong emphasis on advancing these technologies toward preclinical applications. Ultimately, his goal is to overcome key developmental and therapeutic barriers in medicine.

Select Recent Publications:

(1) Zih-An Chen, Cheng-Hsun Wu, Si-Han Wu*, Chiung-Yin Huang, Chung-Yuan Mou, Kuo-Chen Wei, Yun Yen, I-Ting Chien, Sabiha Runa, **Yi-Ping Chen***, and Peilin Chen* **(2024)** Receptor ligand-free mesoporous silica nanoparticles: a streamlined strategy for targeted drug delivery across the blood-brain barrier. ***ACS Nano*** 18, 12716−12736.

(2) Yu-Tse Lee, Si-Han Wu, Cheng-Hsun Wu, Yu-Han Lin, Cong-Kai Lin, Zih-An Chen, Ting-Chung Sun, Yin-Ju Chen, Peilin Chen, Chung-Yuan Mou, and **Yi-Ping Chen*** **(2024)** Drug-free mesoporous silica nanoparticles enable suppression of cancer metastasis and confer survival advantages to mice with tumor xenografts. ***ACS Appl. Mater. Interfaces*** 16, 61787-61804.

(3) Tsung-I Hsu[#], **Yi-Ping Chen**[#], Rong-Lin Zhang, Zih-An Chen, Cheng-Hsun Wu, Wen-Chang Chang, Chung-Yuan Mou, Hardy Wai-Hong Chan, and Si-Han Wu* **(2024)** Overcoming the blood-brain tumor barrier with Docetaxel-loaded mesoporous silica nanoparticles for treatment of Temozolomide-resistant glioblastoma. ***ACS Appl. Mater. Interfaces*** 16, 21722-21735. [#]equal contribution

(4) Julien Dembélé, Jou-Hsuan Liao, Tsang-Pai Liu, and **Yi-Ping Chen*** (**2023**) Overcoming cytosolic delivery barriers of proteins using denatured protein-conjugated mesoporous silica nanoparticles. ***ACS Appl. Mater. Interfaces*** 15, 432-451

(5) **Yi-Ping Chen**, Chien-Tsu Chen, Tsang-Pai Liu, Fan-Ching Chien, Si-Han Wu*, Peilin Chen*, and Chung-Yuan Mou* **(2020)** Catcher in the Rel: nanoparticles-antibody conjugate as NF-κB nuclear translocation blocker. ***Biomaterials*** 246:119997.

Interfacial Hydration Behavior of Linear and Cyclic Polymers Exhibiting Different Bioresponsiveness

Shohei SHIOMOTO[1,2], Shin-Nosuke NISHIMURA[1,3], Naoya KURAHASHI[4,5], Yoshihisa HARADA[5], and Masaru TANAKA[1]

[1]Kyushu Univ., [2]Tokyo Univ. of Sci., [3]Doshisha Univ., [4]Institute for Molecular Science, [5]The Univ. of Tokyo, Japan

Introduction

Poly(2-methoxyethyl acrylate) (PMEA) is a biocompatible polymer utilized for the surface coating of extracorporeal membrane oxygenation (ECMO) systems. When PMEA contacts water, the polymer layer hydrates and swells. However, the relationship between its hydration state and interfacial properties is not entirely clear. Previous research revealed that the amount of hydration is affected by the polymer's topology; cyclic PMEA shows a greater propensity for hydration compared to linear type.[1] In this study, we aim to clarify the relationship between hydration state and biological response by using grafted linear and cyclic PMEA (*gl*- and *gc*-PMEA, respectively).[2]

Experiment

To investigate their biological response, the adhesion amounts of human platelets were counted after contacting the platelet solution. The swelling layers of the PMEAs were observed in water using frequency modulation atomic force microscopy (FM-AFM). The difference for hydrogen bonding of water around the PMEAs was assessed using X-ray emission spectroscopy (XES).

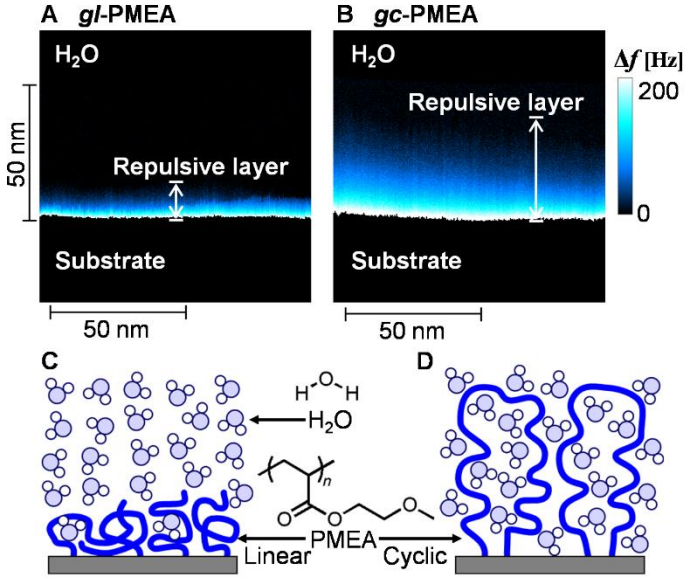

Figure 1. (A, B) FM-AFM images of *gl*-PMEA (left) and *gc*-PMEA (right). Blue gradations indicate frequency changes Δf [Hz] of an AFM cantilever by repulsive force, visualizing the swollen PMEA layers. (C, D) Schematic illustrations of the *gl*- and *gc*-PMEA chains swollen with water.

Results and discussion

Both of the PMEA-grafted surfaces suppressed the adhesion of platelets; however, the *gc*-PMEA shows lower activity of platelets than the *gl*-PMEA, despite both grafted PMEA having the same areal density of MEA units. As shown in **Figure 1**, the FM-AFM observations indicated the existence of repulsive layers on the substrates, corresponding to swollen PMEA layers. The thickness of the swollen *gc*-PMEA layer is thicker than that of the *gl*-PMEA. The results of XES showed that hydrogen bonds or interactions between water molecules developed in the vicinity of *gl*-PMEA but not *gc*-PMEA in the initial hydration region. These differing hydration characteristics may lead to variations in biological responses.

(1) Nishimura, S.; Ueda, T.; Murakami, D.; Tanaka, M. *Org. Mater.* **2021**, *03*, 214–220. (2) Nishimura, S.; Kurahashi, N.; Shiomoto, S.; Harada, Y.; Tanaka, M. *Soft Matter* **2024**, *20*, 9454–9463.

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Education

2021	Ph. D.	Applied Chemistry and Chemical Engineering, Kogakuin University
2018	M. S.	Applied Chemistry and Chemical Engineering, Kogakuin University

Research and Professional Experience

2024-Present	Assistant professor Faculty of Advanced Engineering, Tokyo University of Science
2022-2024	Assistant professor (special project) Institute for materials chemistry and engineering, Kyushu university,
2021-2022	Research fellow of the Japan society for the promotion of science (PD) Institute for materials chemistry and engineering, Kyushu university,
2020-2021	Research fellow of the Japan society for the promotion of science (DC2) Applied Chemistry and Chemical Engineering, Kogakuin university

Publications

1. S. Shiomoto, K. Inoue, H. Higuchi, S. Nishimura, H. Takaba, M. Tanaka, and M. Kobayashi, Characterization of Hydration Water Bound to Choline Phosphate-Containing Polymers, *Biomacromolecules*, **2022**, *23*, 2999-3008.
2. M. Mabrouk, H. H. Beherei, S. Shiomoto, Y. Tanaka, L. Osama, M. Tanaka, Effect of titanium-doped bioactive glass on poly(2-hydroxyethyl methacrylate) hydrogel composites: Bioactivity, intermediate water, cell proliferation, and adhesion force, *Ceramics International*, **2023**, *49*, 13469-13481.
3. S. Shiomoto, H. Higuchi, K. Yamaguchi, H. Takaba, M. Kobayashi, Spreading Dynamics of Precursor Film of Ionic Liquid or Water on Micropatterned Polyelectrolyte Brush Surface, *Langmuir*, **2021**, *37*, 3049-3056.
4. S. Shiomoto, Y. Yamaguchi, K. Yamaguchi, Y. Nogata, M. Kobayashi, Adhesion Force Measurement of Live Cypris Tentacles by Scanning Probe Microscopy in Seawater, *Polym. J.*, **2019**, *51*, 51-59.

Biofabrication of Functionalized Hydrogels: New Frontiers in Regenerative Medicine

Joshua Lim[1)], Sasinan Bupphathong[1)], Hsuan-Ya Tao[1)], Chen-En Yeh[1)], and Chih-Hsin Lin[1)]

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Abstract:

The advancement of regenerative medicine relies heavily on the development of biomaterials that can support cellular function and tissue regeneration. Among these, functionalized hydrogels have emerged as a promising platform for enhancing vascularization within engineered tissues, addressing one of the critical limitations in tissue engineering—insufficient oxygen and nutrient distribution in large constructs. In this study, gelatin methacrylate (GelMA) hydrogels were biofabricated and functionalized with pro-angiogenic growth factors, vascular endothelial growth factor ($VEGF_{165}$) and basic fibroblast growth factor (bFGF), via an EDC/NHS coupling reaction. The conjugation of these growth factors maintained the chemical and physical properties of GelMA while significantly improving cell viability, proliferation, and vascular-like network formation in vitro. Furthermore, a 3D-bioprinted GelMA hydrogel system was developed to investigate the effect of coculturing human adipose-derived stem cells (hADSCs) and human umbilical vein endothelial cells (HUVECs) on vascularization. The results demonstrated that cocultured constructs exhibited enhanced blood vessel formation both *in vitro* and *in vivo*, with the highest vessel density observed in the HUVECs-hADSCs coculture group implanted in mice. These findings highlight the potential of functionalized GelMA hydrogels in promoting vascularization, offering a viable solution for engineering large, functional tissues. This study underscores the significance of biofabricated hydrogels in regenerative medicine and paves the way for their application in developing vascularized tissue constructs for clinical use.

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Education

2011-2016	**National Yang Ming Chiao Tung University (Taipei, Taiwan)** PhD of Science, Department of Dentistry
2007-2010	**National Taiwan University (Taipei, Taiwan)** Master of Science, Institute of Zoology
2004-2007	**National University of Kaohsiung (Kaohsiung, Taiwan)** Bachelor of Science, Department of Life Science

Research and Work Experience

2022-2023	**University of Oxford (Oxford, UK)** Visiting Professor, Department of Chemistry, with Prof. Hagan Bayley
2020-Current	**Taipei Medical University (Taipei, Taiwan)** Associate Professor, Graduate Institute of Nanomedicine and Medical Engineering, College of Biomedical Engineering
2019-2020	**Chang Gung Memorial Hospital (Linkou, Taiwan)** Postdoctoral Fellow, Center for Tissue Engineering, with Prof. Ming-Huei Cheng
2017-2019	**Massachusetts Institute of Technology (Boston, MA, USA)** Postdoctoral Fellow, MIT Koch Institute, with Prof. Robert S. Langer and Prof. Giovanni Traverso.
2016-2017	**National Yang Ming Chiao Tung University (Taipei, Taiwan)** Postdoctoral Researcher, Department of Dentistry, with Prof. Shyh-Yuan Lee and Prof. Yuan-Min Lin.
2011-2016	**National Yang Ming Chiao Tung University (Taipei, Taiwan)** PhD Student, Department of Dentistry, with Prof. Shyh-Yuan Lee and Prof. Yuan-Min Lin.
2013-2014	**Harvard School of Dental Medicine (Boston, MA, USA)** Visiting Student, Department of Developmental Biology, with Prof. Bjorn Olsen.
2010-2011	**Taipei Veterans General Hospital (Taipei, Taiwan)** Research Assistant, Heart Valve Tissue Bank.
2007-2010	**National Taiwan University (Taipei, Taiwan)** Graduate Student, Department of Life Science, with Prof. Hsinyu Lee.

Rational Design of Poly- and Mono-DNA-Functionalized Nanostructures for Biomedical Applications

Yoshitsugu AKIYAMA[1,2)]

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Nucleic acids (DNA and RNA), which play a fundamental role in biological processes, are increasingly recognized as functional materials because of their high molecular recognition ability and low environmental impact [1]. Particularly, gold nanoparticles (AuNPs) with nucleic acids immobilized as brushes (Nuc–AuNPs) form a dense layer of negatively charged nucleic acids on the nanoparticles. This dense layer enhances colloidal dispersibility of the nanoparticles and prevents enzymatic degradation. Furthermore, because Nuc-AuNPs are efficiently internalized by various tissues and cells, they have attracted attention as carriers of nucleic acid drugs that do not require cationic lipid- or polymer-based gene delivery systems [2]. However, for highly efficient *in vivo* delivery of nucleic acids from nanostructures with dense nucleic acid layers, ensuring both safety and control over the intracellular dynamics of Nuc-AuNPs is necessary.

Recently, we fabricated nanostructures that capable of efficiently releasing DNA from DNA-functionalized AuNPs (DNA–AuNPs) under endosomal pH conditions. Particularly, we imparted an acid-responsive function to DNA–AuNPs via Schiff base formation between the terminal amino groups of single-stranded (ss)DNA and aldehyde groups introduced on the AuNP surface [3]. When the nanoparticle dispersion was maintained at a weakly acidic pH, a drastic color change was observed due to surface plasmon resonance associated with particle aggregation. DNA–AuNPs containing fluorescent dyes exhibited increased fluorescence intensity under weakly acidic conditions, suggesting the desorption of ssDNA from the AuNPs. We then engineered the inner core to support the outermost DNA layers and designed nanostructures capable of self-immolation upon exposure to external stimuli. The self-assembly of ssDNA with self-immolative poly(carbamate) (PC) derivatives yielded ssDNA-dense nanostructures [4], paving the way for nano-sized drug delivery systems (nanoDDS) that can release nucleic acid drugs through a self-immolative chain fragmentation of PC containing fluorescent monomers as repeating units.

Nucleic acid nanostructures are also promising tools for bioanalytical techniques. For instance, a simple colorimetric assay for bleomycin (BLM) derivatives was developed by incorporating the DNA cleavage site of the DNA-affinity drug BLM into the outermost layer of DNA–AuNPs [5]. Notably, we gained insights that enabled the visual identification of DNA cleavage pathways that could not be achieved by fluorescence analysis [6]. Furthermore, we developed fluorescent nucleic acid imaging materials using AuNPs as quenchers to prepare molecular beacon-monoconjugated nanostructures with both target specificity and quantitative capabilities [7]. In this study, we also presented a rational structural design for monoconjugates, which conjugate single-stranded functional polymers onto a single AuNP [8].

REFERENCES: [1] Y. Akiyama, *Nano Biomedicine*, **2024**, *16*, 1. [2] C. A. Mirkin *et al*., *ACS Nano*, **2023**, *17*, 16291. [3] Y. Akiyama *et al*., JPN Patent No. 073950, **2024**. [4] S. Fukumoto *et al.*, *Anal. Sci*., **2021**, *37*, 781. [5] Y. Akiyama *et al*., JPN Patent No. 717869, **2022**. [6] Y. Akiyama *et al*., *ChemBioChem*, **2023**, *24*, e202200451. [7] A. Mukaida *et al*., *Anal. Sci.*, **2021**, *37*, 785. [8] Y. Akiyama *et al*., JPN Patent Application No.150544, **2024**.

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Education

1998 B.S., Industrial Science and Technology, Tokyo University of Science

2003 Ph.D., Materials Engineering, The University of Tokyo

Careers

The University of Tokyo *(Department of Materials Engineering)*

2003-2004 Japan Society for the Promotion of Science Research Fellow

University of Virginia *(Department of Chemistry)*

2004-2008 Research Associate, Research Scientist

Arizona State University *(Center for Bioenergetics, The Biodesign Institute)*

2008-2009 Assistant Research Scientist

2009-2010 Research Assistant Professor

NOF Corporation *(PEGylation Materials, DDS Research Laboratory)*

2010-2012 Senior Research Scientist, Team Leader

RIKEN *(Bioengineering Laboratory)*

2012-2015 Cooperative Researcher

Tokyo University of Science

2015-2018 Assistant Professor (*Faculty of Industrial Science and Technology*)

2019-2021 Associate Professor (*Faculty of Industrial Science and Technology*)

2021-Present Associate Professor (*Institute of Arts and Sciences*)

2021-Present Associate Professor (*Graduate School of Advanced Engineering, Concurrent Position*)

Affiliated Position

2021-Present Visiting Researcher (*Cluster for Pioneering Research, RIKEN*)

2021-Present Adjunct Lecturer (*College of Science, Rikkyo University)*

Awards

2014 Poster Presentation Award for 2nd International Symposium on Smart Biomaterials

Injectable ChitHCl-DDA tissue adhesive for tear meniscus repair and regeneration

Kuan-Hao Chen[1)], Wei-Ru Wang[2)], Chieh-Ying Chen[2)], Pei-Chun Wong[2)*]

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[2)]Graduate Institute of Biomedical Optomechatronics, College of Biomedical Engineering, Taipei Medical University, Taipei, Taiwan

Suture pull-through remains a significant challenge in meniscus repair surgery due to the sharp leading edges of sutures. While various tissue adhesives have been developed as alternatives to traditional suturing methods, none have proven fully suitable for meniscus repair due to limitations in biosafety, biodegradability, sterilizability, and tissue-bonding efficacy. In this study, we developed a tissue adhesive composed of chitosan hydrochloride (ChitHCl) and periodate-oxidized dextran (DDA), combined with a chitosan-based hydrogel and oxidative dextran, for enhanced meniscus attachment.

Comprehensive material characterization was performed through viscoelasticity and viscosity assessments, lap shear stress tests, Fourier transform infrared (FTIR) spectroscopy, swelling ratio analyses, and degradation behavior evaluations. Cellular responses were investigated using MTT assays, alcian blue staining, migration assays, cell behavior observations, and protein expression analysis. Furthermore, ex vivo and in vivo evaluations were conducted to assess the biocompatibility and regenerative potential of the ChitHCl-DDA adhesive.

The findings demonstrated that the ChitHCl-DDA adhesive exhibited superior tissue adhesive strength, excellent biocompatibility, and favorable cell responses. These results highlight the potential of the ChitHCl-DDA tissue adhesive as a promising solution for meniscus repair and regeneration, addressing critical limitations of existing adhesive technologies.

Pei-Chun Wong

Assistant Professor, Graduate Institute of Biomedical Optomechatronics, Taipei Medical University, Taipei, Taiwan (2022.10-)

Experience

- Adjunct Assistant Professor, Department of Biomedical Engineering, National Defense Medical Center, Taiwan (2022.08-2024.07)
- Medical Research Fellow, Department of Orthopedics, Taipei Medical University Hospital, Taiwan (2020.09-2022.10)
- Postdoctoral Fellow, School of Biomedical Engineering, Taipei Medical University, Taiwan (2017.07-2020.08)
- Visiting Postdoctoral Fellow, Department of Biomedical Engineering, Case Western Reserve University, US (2017.07-2017.08)

Education

Ph.D. in Biomedical Engineering, National Yang-Ming University, Taipei, Taiwan (2017)

Selected Publication

1. K.H. Chen, W.R. Wang, C.Y. Chen, Y.B. Lee, C.H. Chen, **P.C. Wong***. Injectable ChitHCl-MgSO4-DDA hydrogel as a bone void filler to improve cell migration and osteogenesis for bone regeneration. ***Biomaterials Advances***, 2024, 163, 213963.
2. **P.C. Wong**, K.H. Chen, W.R. Wang, C.Y. Chen, Y.T. Wang, Y.B. Lee, J.L. Wu. Injectable ChitHCl-DDA tissue adhesive for tear meniscus repair and regeneration. ***International Journal of Biological Macromolecules***, 2024, 270, 132409.
3. **P.C. Wong**, D. Kurniawan, J.L. Wu, W.R. Wang, K.H. Chen, Y.C. Chen, C.Y. Chen, K.K. Ostrikov, W.H. Chiang. Plasma-Enabled Graphene Quantum Dot Hydrogel Magnesium Composites as the Bioactive Scaffolds for In Vivo Bone Defect Repair. ***ACS Applied Materials & Interfaces***, 2023, 15, 44607-44620.
4. **P.C. Wong**, S.M. Song, Y.Y. Nien, W.R. Wang, P.H. Tsai, J.L. Wu, J.S.C. Jang. Mechanical properties enhanced by the dispersion of porous Mo particles in the biodegradable solid and bi-phase core–shell structure of Mg-based bulk metallic glass composites for applications in orthopedic implants. ***Journal of Alloys and Compounds*** 2021, 877, 160233.
5. S.M. Song, P**.C. Wong***, C.W. Chiang, P.H. Tsai, J.S.C. Jang*, C.H. Chen*. A bi-phase core–shell structure of Mg-based bulk metallic glass for application in orthopedic fixation implants. ***Materials Science and Engineering C*** 2020, 111, 110783.

Day 1 Sat. March 8th, 2025

11:05-12:35

Session B. Device & Robotics

Chairs:

Prof. Hiroshi TAKEMURA (TUS) /

Prof. Bing-Shiang YANG (NYCU/ITRI)

Computational simulation of tumor evolution based on omics data

Hiroshi HAENO[1)], Koichi Saeki[1)]

[1)]Research Institute for Biomedical Sciences, Tokyo University of Science

It is the well-accepted concept that tumors evolve under the pressure of immune responses and escape from them. Immune checkpoint inhibitors (ICIs) are expected to reactivate antitumor immunity and inhibit tumor progression. However, the durable benefits by ICI treatments are limited to the minority of patients. Therefore, it is important to study the mechanisms of tumor evolution interacting with immune cells and to reveal the condition that ICIs become effective.

To understand the tumor evolution under immune pressure we developed a computational model. A simulation model starts from one tumor cell until the total number of cells reaches 10^6 or 0. We assume that an intrinsic tumor growth rate is common among each tumor cell, which is denoted by *r*. The cell death rate, however, differs among each tumor cell according to the number of harboring antigenic and escape mutations. The possibility of mutations arises when a cell divides with probability p_A for an antigenic mutation and p_E for an escape mutation. The cell death rate increases with the number of antigenic mutations and decreases with that of escape mutations. Here, we define the cell death rate for *i*-th clone d_i as follows:

$$d_i = \alpha k_i e^{-\beta n_i},$$

where k_i and n_i are the numbers of antigenic and escape mutations in the *i*-th clone, respectively, and α and β are the immunoreactive or immunoescape effects per mutation, respectively. A new clone branches from a parental clone once mutation arises. By setting $\alpha = 0$, the cell death rate becomes zero regardless of the mutation profile of a cell. This is the setting of the neutral case in our simulation. The stochastic dynamics of tumor cell populations is simulated by the Gillespie algorithm. To replicate the multiregional sequencing data, our simulation was conducted on a lattice space. Cell migrations are not considered in our simulation.

We performed simulations with and without selective pressure mimicking the situations of MSI-H and MSS CRCs, respectively. We additionally executed *in silico* multiregion sequencing and compared the multiregion mutation profiles to those from the real tumors. We further examined the distributions of the VAFs derived from 10 Monte Carlo trials with and without immune selective pressure. Overall, we found that the VAFs of shared mutations of tumors simulated with selective pressure assuming MSI-H CRCs were significantly higher than those of tumors without selective pressure assuming MSS CRCs, which was consistent with the clinical data.

CURRICULUM VITAE (CV)

Name: Hiroshi Haeno

Age: 42

Research Institution, Academic Unit (School, Faculty, etc.) & Position:

Tokyo University of Science, Research Institute for Biomedical Sciences

Associate Professor

Academic Degree: Ph.D.

Research Career and Experience:

2022-04 – present Associate Professor, Tokyo University of Science

2019-04 – 2022-03 Project Associate Professor, The University of Tokyo

2018-04 – 2019-03 Project Researcher, National Cancer Center

2013-04 – 2018-03 Assistant Professor, Kyushu University

2010-09 – 2012-11 Research Fellow, Dana-Farber Cancer Institute

Selected publication:

1. Uryu H, …, **Haeno H**, …, Takahashi K. Clonal evolution of hematopoietic stem cells after myeloma targeting chemotherapy and autologous stem cell transplantation. ***Nat Genet.*** Accepted.
2. Kobayashi Y, …, **Haeno H,** …, Mimori K. Subclonal accumulation of immune escape mechanisms in microsatellite instability-high colorectal cancers. ***Br. J Cancer.*** 129:1105-1118. 2023. (doi: 10.1038/s41416-023-02395-8.)
3. Kawazu M, …, **Haeno H**, Nishikawa H, Mano H. HLA Class I Analysis Provides Insight Into the Genetic and Epigenetic Background of Immune Evasion in Colorectal Cancer With High Microsatellite Instability. ***Gastroenterology.*** 162:799-812. 2022. (doi: 10.1053/j.gastro.2021.10.010.)
4. Yamamoto KN, Yachida S, Nakamura A, Niida A, Oshima M, De S, Rosati LM, Herman JM, Iacobuzio-Donahue CA, **Haeno H**. Personalized Management of Pancreatic Ductal Adenocarcinoma Patients through Computational Modeling. ***Cancer Res.*** 77:3325-3335 2017. (doi: 10.1158/0008-5472.CAN-16-1208.)
5. **Haeno H***, Gonen M*, Davis MB, Herman JM, Iacobuzio-Donahue CA, Michor F. (*co-first authors) Computational modeling of pancreatic cancer reveals kinetics of metastasis suggesting optimum treatment strategies. ***Cell*** 148(1-2):362-75. 2012. (doi: 10.1016/j.cell.2011.11.060.)

Microsphere Drug Delivery Improvement by Microfluid Systems

Te-Yu Tsou[1], Yi-Wei Lin [1]

[1] Ultra Precision Machinery Technology Department, Industrial Technology Research Institute

Microsphere carrier injection has become a developing trend for long term drug delivery. Microsphere drugs are produced by encapsulating target drug chemicals in biodegradable polymers, like PLGA. Once the microsphere enters human body, it will slowly dissolve from the outside. This will gradually release small dose of drug it contains over a period of time. Unlike traditional pills, which dissolve immediately after consumption, microsphere drugs can control the released dosage on a desired level. This can increase the effect of the treatment while avoiding side effects due to high dosage. Also, by adjusting the components and sizes of the microspheres, we can control and extend the time each microsphere fully dissolved. This prolongs the effect of each treatment and lowers the frequency a patient needs to take the injection. Microsphere drugs can provide a much more stable and convenient treatment for a wide range of disease.

Currently, most of microsphere drugs were manufactured by emulsify tank. This method mixes large volume of polymers and drug chemicals and gradually forms individual microsphere by constant stirring. Though this can provide enough throughput for the market need, its low yield rate is undesirable. If the product microspheres have low homogeneity, its medical effect will vary between each batch. And due to its high complexity in parameter control and high cost of raw materials, the development of new microsphere drug is very slow despite its advantages. A few companies have started investing in other methods for manufacture, like microfluid systems. But due to producing microspheres being multi-step process including emulsification and solidification, optimizing the entire system is still difficult. And in order to meet the output requirement for commercial use, it needs to withstand a stable high flow rate within each step of microfluidic chip. Most of the current research is still in laboratory stage or a single chip for one part of the process, only few companies did put out fully system for commercial products. And there's rarely any example with a microfluid system for solidification process, possibly due to it being the last step of manufacture with highest flow rate long processing time.

The goal of our project is to develop a microfluidic chip use for microsphere solidification process that meet the needs of commercial use in terms of throughput and high yield, while also can integrate with emulsification chips into a single system. The solidification chip will take the microsphere produced by the emulsification process and remove the solvent inside, turning it into a solid particle with drugs encapsulate in it. We want to improve homogeneity and lower the requirement of organic solution by microfluid system control, which is the main disadvantage of traditional emulsify tank. We also want to raise the efficiency of solidification mechanism by incorporate high shear stress baffle structure, thus lowering the processing time of each individual microsphere. The result chips will be able to connect to emulsification chips and form a high throughput continuous producing system. By integrating microfluidic chips for each process of the manufacture, we provide an alternative solution for the rising demand of stable microsphere drugs.

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Personal Details

A researcher in microfluidic system for biomedical and biochemical application. With related experience in fluid simulation, MEMS fabrication, microfluidic experiment, cell culture and biomaterial operation.

Education

MS in Power Mechanical Engineering **2024**

National Tsing Hua University, Hsinchu, Taiwan R.O.C

Dissertation Title: "Embryo and Fibroblast Co-culture Microfluidic Chip with Physical PDMS Surface Modification"

Advisor: Da-Jeng Yao, Professor, NTHU

BS in Engineering and System Science **2021**

National Tsing Hua University, Hsinchu, Taiwan R.O.C

Research Experience

Deputy Engineer **2024-present**

Industrial Technology Research Institute, Hsinchu, Taiwan R.O.C

- Simulation and analysis for blood processing microfluidic chips.
- Development of microfluidic chips used for cancer cell culture.
- Design of microreactor for microsphere drug production.

User Performance Based on the Effects of Low Video Latency

Tomohiko Hayakawa[1)]

[1)] Tokyo University of Science

The latency of immersive devices significantly affects user experience, causing VR sickness and reducing immersion. It has been suggested that there is a threshold for performance degradation and perceivable latency time at latencies smaller than 100 ms from user input to display on the screen, and the search for smaller latency time regions is important [1]. To investigate the acceptable limits of video latency, we developed a system utilizing a high-speed camera and projector operating at 1000 fps (Fig. 1). This system achieved a minimum latency of 4.3 ms and allowed for precise latency adjustments with 1 ms resolution. Through experiments with 20 participants performing pointing tasks, as shown in Fig. 2, we observed that system latencies below 23.3 ms had minimal impact on task performance, whereas performance degraded when latency exceeded 44.3 ms [2]. This suggests a critical latency threshold between 24.3 ms and 44.3 ms for optimal performance. Additionally, by integrating real-time CG hand rendering into the system, we maintained a minimum latency of 10.16 ms, ensuring an acceptable range even with graphical modifications.

These findings provide valuable insights into designing next-generation XR devices, emphasizing the importance of low-latency systems for enhancing user interaction and minimizing discomfort. Future research will extend this approach to more complex interactive scenarios and explore spatial variables alongside temporal latency constraints. Especially, applications in environments where XR space is essential, such as remote work in space and surgical robots, are expected.

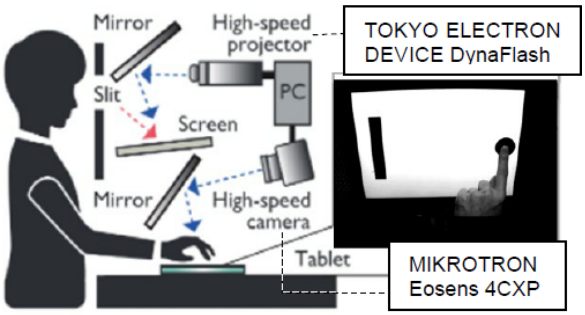

Fig.1 System overview

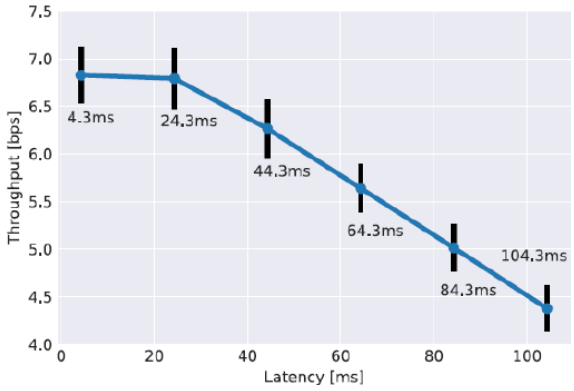

Fig. 2 Task performance results

[1] R. Jota et al., “How fast is fast enough? a study of the effects of latency in direct-touch pointing tasks.” In Proceedings of the sigchi conference on human factors in computing systems (pp. 2291-2300). (2013).

[2] T. Kadowaki et al. , “Effects of Low Video Latency under the Immersive Environment with a Gap between Visual Information and Physical Sensation.” Transactions of the Virtual Reality Society of Japan, Vol.24, No.1, pp.23-30, (2019).

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Education:

- Doctor of Information Science and Technology, The University of Tokyo, May 2016
- Master of Information Science and Technology, The University of Tokyo, March 2010
- Bachelor of Information and Computer Science, Keio University, March 2008

Professional Experience:

- Associate Professor, Information Technology Center, Tokyo University of Science, April 2023 – Present
- Project Associate Professor, Research Institute for Science and Technology, The University of Tokyo, April 2020 – March 2023
- Assistant Professor, Department of Information Physics and Computing, The University of Tokyo, November 2017 – March 2020
- Project Assistant Professor, Department of Creative Informatics, The University of Tokyo, July 2016 – October 2017

Research Interests:

- High-Speed Vision Systems
- Sensor Fusion
- Dynamic Perception and Control
- Infrastructure Inspection Technologies

Awards and Honors:

- 2021: The 9th Robot Award, Excellent Prize
- 2021: 4th Infrastructure Maintenance Award, Minister of Land, Infrastructure, Transport and Tourism Award
- 2020: 42nd Annual Conference Best Presentation Award, Tokyo Branch
- 2020: Innovative Technologies 2020 Special Prize - Vision
- 2020: 22nd VRSJ Outstanding Paper Award

Selected Publications:

- Yushi Moko, Yuka Hiruma, Tomohiko Hayakawa, et al., “Vehicle Self-Position Estimation Using Lighting Recognition in Expressway Tunnel,” *Journal of Robotics and Mechatronics*, 2024.
- Yuriko Ezaki, Yushi Moko, Tomohiko Hayakawa, et al., “Angle of View Switching Method at High-Speed Using Motion Blur Compensation,” *Journal of Robotics and Mechatronics*, 2022.
- Tomohiko Hayakawa, Yushi Moko, Kenta Morishita, et al., “Tunnel Surface Monitoring System with Angle of View Compensation,” *Journal of Robotics and Mechatronics*, 2022.

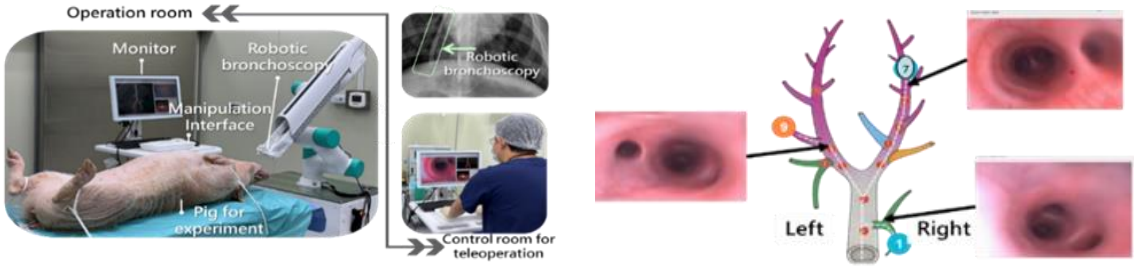
Development of Robotic Bronchoscopy with Structure-Image-Based Planning and Navigation: Results from Animal Testing.

Cheng-Peng Kuan [1)], Chien-Yu Wu [1)], Bing-Shiang Yang [1)]

[1)]Industrial Technology Research Institute, Taiwan

There still exist uncured injuries, e.g., pulmonary fibrosis, inside the lungs of most of people infected by COVID-19. A robotic bronchoscopy with omni-directional bending section within 4mm outer diameter and a 1mm-diameter working channel for MSC (Mesenchymal Stem Cells) spraying and direct medication to the target areas. This robotic bronchoscopy can be manipulated automatically or manually by a surgeon based on the proposed structure/image-based path planning and navigation control algorithm. In this paper, animal experiments in vivo on an adult pig are conducted for verification. Results support the effectiveness of the developed robotic bronchoscopy.

The robotic bronchoscopy is capable of moving along the bronchial tree inside the lungs for following treatments. The bending section of this robotic bronchoscopy is made by precise laser engraving where specific pattern is on the surface of the stainless-steel tube (with diameter < 4mm) and several sub-sections with 90^{o} interlaced are made for omni-directional bending. At the tip of the bending section a CMOS camera is mounted. Path planning and navigation is performed based on the 3D Bronchial Tree derived from CT images and its invariant feature via object/feature recognition by visual information captured by the CMOS camera in real-time, in situ, and in vivo manner. The animal testing with an adult pig is as shown in Figure 1.



(a) **(b)**

Figure-1. Animal testing. (a) system set-up, (b) real images captured at different positions 1, 7, & 9.

Figure-1(b) shows the results from animal experiments in vivo on an adult pig where successful path planning and navigation is achieved. The robotic bronchoscopy is navigated automatically by recognizing the bronchial tree structure where the path planning is applied in advance. The animal experiments on an adult pig demonstrate the effectiveness of the developed robotic bronchoscopy and the path planning/navigation mechanism. Currently, a force controlled-contact navigation is under developing for dexterous interventions.

Dr. Curtis (Cheng-Peng) Kuan has worked in ITRI at Mechanical and Mechatronics Systems Research Labs, Intelligent Robotics Technology Div. since 2016. He received degrees of Bachelor (1993), Master (1995), Ph.D. (2000) from Dept. Electrical and Control Engineering of National Chiao Tung University (now National Yang Ming Chiao Tung University). Main research focuses are Robotics, Virtual Reality and Image Processing, and Artificial Intelligence. He worked for ITRI-Information and Communications Research Labs (2001~2004, 2006~2011), Advanced Digital Broadcasting (2005), and Silicon Integrated System (2012), focusing mainly on technologies related to Digital Television and Waltop (2013~2016) with Digital Stylus business. He published several technical papers related to DTV, Digital Rights Management, Robotics, and Robotic Bronchoscopy and won the best paper awards from 5th World Congress on Micro and Nano Manufacturing ("The Design and Control Scheme of Miniature Serpentine Robot for In-Body Visual Servo Applications", 2022) and the 25th International Symposium on Advances in Abrasive Technology ("An AI-enabled Robotic Grinding/Polishing System", 2023). He participated several research projects including European Commission FP5-MUFFINS, FP6-TIRAMISU, and Horizon Europe-HARTU projects and made contributions to standardization activities – ATSC (US DTV Standards, Advanced Television Systems Committee), DVB (Europe DTV Standards, Digital Video Broadcasting), OMA (Mobile Standards, Open Mobile Alliance), and USI (Digital Stylus Standards, Universal Stylus Initiative).

Reliability Assessment of Non-contact Vital Sign Sensing for Monitoring Robot

Takuya HASHIMOTO[1)], Tatsuhisa ISHIDA[1)], Keisuke KITANO[1)], Guanghao SUN[2)]

[1)]Department of Mechanical Engineering, Tokyo University of Science

[2)] Graduate School of Informatics and Engineering, The University of Electro-Communications

This study focuses on the development of a robot capable of non-contact measurement of two vital signs—heart rate and respiration rate—using multiple sensing devices under various environmental conditions. The increasing demand for non-contact vital sign monitoring, especially in healthcare settings post-COVID-19, has highlighted the limitations of existing non-contact methods, which often assume static environments and stationary subjects. To address this, we integrated an RGB camera, a microwave sensor, and a thermal camera into a mobile robot system.

The RGB camera captures skin color variations to estimate heart rate using remote photoplethysmography (rPPG). The microwave sensor detects chest motion via the Doppler effect, while the thermal camera tracks nasal temperature fluctuations to measure respiration rate. A machine learning–based reliability assessment method was introduced to evaluate the quality of acquired signals. We trained a Random Forest (RF) model using various signal features and classified the reliability of both heart rate and respiration rate measurements.

Experimental validation was conducted under different conditions, varying subject orientation, clothing, ambient light, distance, and posture. Measurements from the proposed system were compared with reference signals from contact sensors. Experimental results demonstrated high measurement accuracy for respiration rate in ideal conditions. However, accuracy declined under low-light conditions and when the subject was standing, due to reduced signal strength and sensor misalignment. The RF-based reliability assessment achieved a high sensitivity for heart rate and respiration rate.

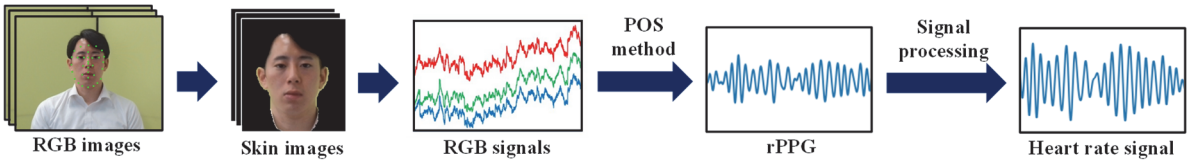


Fig. 1 Measurement flow of Heart rate signal

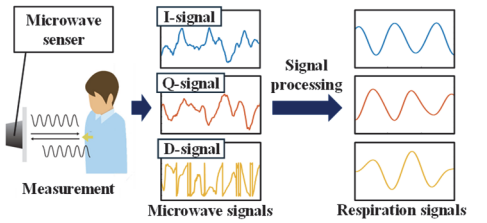


Fig. 2 Measurement flow of Respiration signals

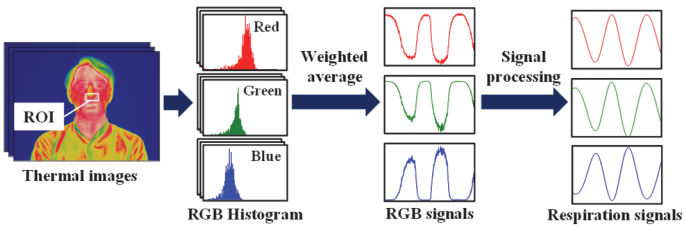


Fig. 3 Measurement flow of Respiration signal

CV

Takuya HASHIMOTO received the B.S., M.S., Ph.D. degrees in mechanical engineering from Tokyo University of Science, Tokyo, Japan, in 2004, 2006, and 2009, respectively. From 2009 to 2013, he was an Assistant Professor at the Department of Mechanical Engineering, Tokyo University of Science. From 2013 to 2016, he was an Assistant Professor at the Department of the Mechanical and Intelligent Systems, the University of Electro-Communications. He was appointed as a lecturer in 2016 and Associate Professor in 2022 (to date) at the Department of Mechanical Engineering, Tokyo University of Science, Tokyo, Japan. He is interested in Robotics, Human-robot Interaction (HRI), HRI Evaluation, Sociability of Robots, Welfare Robots, Human Interface.

Integrated mobile system for tremor diagnosis

Chih-Hao Liu[1], Bing-Shiang Yang[1,2]

[1]Biomechancis & Medical Applications Lab, National Yang Ming Chiao Tung University, Hsinchu , Taiwan

[2]Dept. Mechanical & Mechatronics, Industrial Technology Research Institute, Hsinchu, Taiwan

Essential Tremor (ET) is a common motor disorder affecting elderly populations [1], leading to significant challenges in daily living. Traditional methods for diagnosing and evaluating ET, particularly in clinical settings, are often time-consuming and subjective. This study proposes a novel integrated system that combines an iPad-based spiral drawing test with electromyography (EMG) from a MYO armband, creating a portable diagnostic tool to identify tremor-contributing muscles. This system aims to improve diagnostic accuracy and assist in Botulinum Toxin (BTX) treatment planning by providing both objective data and efficient results.

The system consists of a third-generation iPad Pro, paired with an Apple Pencil 2 and a MYO armband, both running at a 200Hz sampling rate. The iPad records spiral-drawing data while the MYO armband captures EMG signals, both of which are synchronized via Bluetooth for real-time analysis. A total of 11 participants (7 males, 4 females; mean age 69.8 ± 5.5 years) participated, all of whom scored at least one point on the Fahn-Tolosa-Marin Tremor Rating Scale (FTM-TRS). Participants were evaluated before and after treatment, undergoing a series of tests including grip strength measurement, muscle activation analysis, and five guided spiral drawings with the arm elevated.

The data were processed using Swift and MATLAB. The study evaluated four key spiral-drawing parameters—dr/dt SD, dr/dθ Mean, main frequency, and area under the curve—and found strong reliability with intraclass correlation coefficients (ICC) averaging 0.82. This new platform demonstrated significant improvements in operational efficiency, with a 52.5% reduction in setup time and an 80% reduction in weight compared to previous systems [2]. Furthermore, a novel two-dimensional muscle contribution graph effectively ranked tremulous muscles based on average EMG values and their correlation with the spiral-drawing parameters. This feature facilitated the identification of tremulous muscles and provided insights into treatment efficacy.

In conclusion, the integrated diagnostic system proved to be a reliable and efficient tool for assessing tremor severity and identifying tremor-contributing muscles. The reduction in operation time, combined with the ability to provide objective and actionable data, holds promise for improving clinical decision-making, particularly for BTX treatment. Future research will focus on larger-scale validation and additional refinements to enhance clinical applicability.

References

[1] Niemann, N., & Jankovic, J. (2018). *Toxins*, ***10*****(7)**, 299.

[2] Lin et al. (2018) *BMC Neurol*, ***18*****(1)**, 25.

CHIH HAO LIU

MECHANICAL ENGINEER

CONTACT

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EDUCATION

2018 - 2022
NYCU

- Bachelor of Mechanical Engineering
- GPA : 3.3

2022 - 2025
NYCU

- Master of Mechanical Engineering
- GPA: 4.0

SKILLS

- 3D Drawing (Inventor 3D, solid words, Fusion 360)
- 3D Scanning/ Comparison (Control X)
- Coding (python, Matlab, C++)
- Machine Learning/Ai
- iOS App design (Swift, Story Board)

LANGUAGES

- English (Fluent, TOEIC 945)
- Mandarin (Native)

PROFILE

Born in Yonghe District, New Taipei City, I was raised in a bilingual household that emphasized global perspectives. Early experiences, such as living in the U.S. and participating in a year-long exchange program in Denmark, fostered my independence and cross-cultural communication skills. I later pursued both a bachelor's and a master's degree in mechanical engineering at National Yang Ming Chiao Tung University (NYCU).

WORK EXPERIENCE

Industrial Technology Research Institute 2023/1 - 2024/12
Mechanical Engineer Intern

Assisted with departmental project implementation at ITRI, primarily responsible for tasks including but not limited to:

- Mechanical drafting and design
- Component assembly
- Process optimization
- Quality control (surface tolerance evaluation)
- Supporting large-scale experiments
- Identifying alternative materials
- Researching and organizing literature and methodologies

Proficient in:
#Inventor #SolidWorks #MechanicalDrafting #ProductMechanismDesign #NewProductDevelopmentAndTesting #PrototypeEvaluation

MASTER THESIS

My master's thesis focuses on developing an iOS app for iPad to address clinical challenges in assessing and treating hand tremors. It combines the Archimedean spiral test with the MYO armband to collect surface electromyography (sEMG) data, enabling real-time quantification of tremor severity and identification of affected muscles. Advanced signal processing techniques provide clinicians with insights, while a novel algorithm accurately localizes tremor-affected muscles, improving botulinum toxin injection therapy by optimizing dosage and sites. This system aims to enhance treatment for conditions like Parkinson's disease and essential tremor, integrating technology with clinical practice for better healthcare outcomes.

Day 1 Sat. March 8th, 2025

14:05-15:45

Session C. Special

Chairs:

Prof. Hiroaki HOBARA (TUS) /

Prof. Cheng-Yu TSAI (TMU)

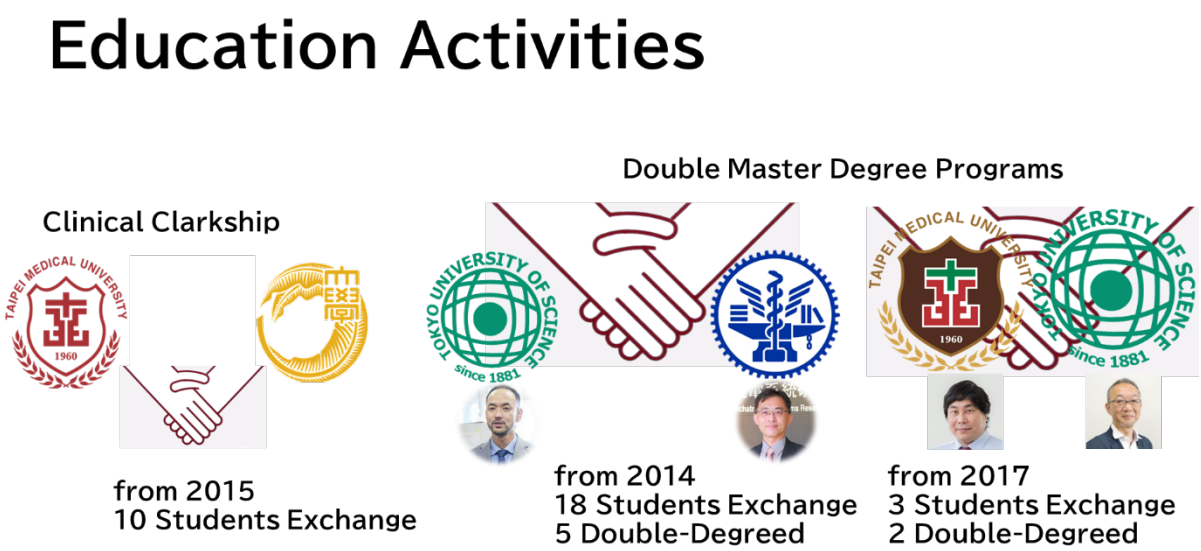
Special Session Introduction

Kohei SOGA[1, 2)]

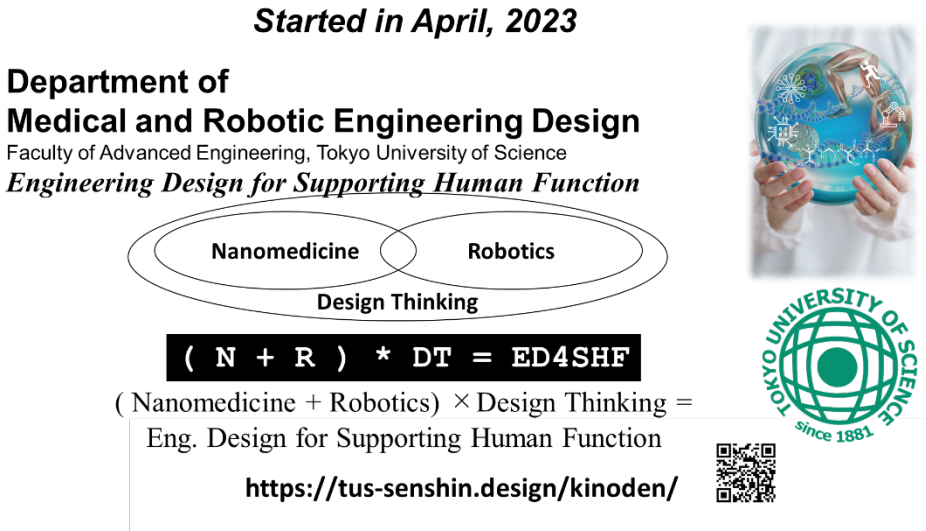
[1]Department of Medical and Robotic Engineering Design, Tokyo University of Science, Tokyo, Japan

[2]Risearch Institute for Biomedical Sciences, Tokyo University of Japan, Chiba, Japan

As have been discussed, the activity of the IBMI is the exchange of Biomedical and Non-Biomedical people for collaborative works on research. Beside them, the "education" collaborations are on going as clinical clerkship and double master degree programs.



The exchange between Department of Materials Science and Technology (DMST) of Tokyo University of Science(TUS) and the Institutes of Taipei Medical University(TMU) started in 2017. On the other hand, TUS started a new undergraduate department, Department of Medical and Robotic Engineering Design (DMRED) in 2023. Most of the researchers in the DMST who are researching on biomedical topics moved to the new department, DMRED. The concept of the DMRED is innovatively create the "***Engineering Design for Supporting Human Function***" to solve the present and future problems of the population decline. The department consists of three fields, Cognition, Medical and Robotic Function Designs. To date, in the past IBMI, "medical function design" members already have been joined. The aim of this special session is to let people exchange in the field of "cognitive and robotic function designs."



Pushing Boundaries: Prosthetic Technology and the Limits of Human Performance

Hiroaki HOBARA[1)]

[1)]Tokyo University of Science

The physical and psychosocial benefits of sports and recreational activities for individuals with lower-limb amputation are well-documented; however, their participation in these activities remains limited. Running has become a prevalent form of exercise and a means of engaging in sports and recreation for this population. Further, recent developments in carbon-fiber running-specific prostheses (RSPs) with elastic energy storage and return functions have allowed individuals with lower extremity amputation to regain the functional capability of running. Moreover, key milestones, breakthrough technologies, and the collaborative efforts of researchers, engineers, and prosthetists push the boundaries of human performance limitations in running and jumping. Indeed, the world records of Men's 100-m sprint and long jump in T62/64 class (bilateral/unilateral transtibial amputation) at Para-athletics are 10.54 s and 8.72 m, respectively (as of February 14, 2025). This phenomenon exemplifies how para-athletes are highly motivated and work hard as well as how current prostheses have advanced. This raises the following question: How fast would RSPs allow Para-athletes to run in the future? As shown in these records, there are many para-athletes using RSPs who are now able to run faster and achieve longer jumps than able-bodied athletes. However, ironically, this phenomenon has raised a debate in the scientific community regarding the potential advantages or disadvantages of RSPs compared to able-bodied counterparts in athletics, as represented by 'Technology Doping'. In this lecture, the history, current world records, and biomechanics of RSPs in athletics will be introduced. Finally, a debate regarding the advantages or disadvantages of RSPs will be presented.

Curriculum Vitae

Hiroaki Hobara, Ph.D.

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1. CURRENT APPOINTMENT

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2. EDUCATIONAL BACKGROUNDS

- 1999 – 2003 B.Sc. in Sports and Health Sciences, Juntendo University, Japan.
- 2003 – 2005 M.Sc. in Human Sciences, Waseda University, Japan.
- 2005 – 2008 Ph.D.in Human Sciences, Waseda University, Japan.

3. WORK EXPERIENCE

- 2008-2011 Postdoctoral Researcher, National Rehabilitation Center for Persons with Disabilities, JPN
- 2011-2013 Research Fellow, Japan Society for the Promotion of Science (JSPS), Tokyo, JPN
- 2011-2013 Research Associate, Department of Kinesiology, University of Maryland, MD, USA
- 2013-2017 Research Fellow, Digital Human Research Center, National Institute of AIST, JPN
- 2015-2017 Research Fellow, Human Informatics Research Institute, National Institute of AIST, JPN
- 2017-2022 Senior Researcher, Artificial Intelligence Research Center, National Institute of AIST, JPN
- 2022-2023 Associate Professor, Faculty of Advanced Engineering, Tokyo University of Science, JPN

4. SOCIAL ACTIVITIES

- 2020-2021 Board Member, International Society of Biomechanics in Sports
- 2021-current Associate Editor: Sports Biomechanics
- 2021-current Associate Editor: Frontiers in Sports and Active Living
- 2023-current Board Member (Appointed), International Society of Biomechanics
- 2023-current Board Member, Asian Society of Sports Biomechanics
- 2024-current Editorial board: Journal of Applied Biomechanics
- 2025-current CTO, BRUSH-UP WORKS Inc.

Research of Rehabilitation Technology: Wearable Device and Robotic Assist Gait Training

Li-Fong Lin[1,2)]

[1)] School of Gerontology and Long-Term Care, College of Nursing, Taipei Medical University, Taipei, Taiwan
[2)] Department of Physical Medicine and Rehabilitation, Shuang Ho Hospital, Taipei Medical University, New Taipei City, Taiwan

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Background

Stroke is a major cause of disability, affecting motor function and quality of life. Traditional rehabilitation has limitations, prompting interest in wearable devices and robot-assisted gait training (RAGT). This study evaluates their feasibility and efficacy in upper limb and gait rehabilitation.

Methods

Wearable Devices for Upper Limb Rehabilitation

Eighteen chronic stroke patients were randomized into a wearable device or control group. All received conventional rehabilitation, but the device group underwent an additional 15 sessions over 3–5 weeks. Key assessments included Fugl-Meyer Assessment (FMA), active range of motion (AROM), and deviation angle.

Hybrid Robot-Assisted Gait Training (RAGT)

Forty subacute stroke patients were randomized to RAGT plus conventional rehabilitation or conventional rehabilitation alone. Assessments included FMA-Lower Extremity (FMA-LE), Berg Balance Scale (BBS), and Timed Up and Go (TUG), measured before, after, and 3 months post-intervention.

Results

Wearable Devices

Significant improvements in FMA total and shoulder/elbow/forearm subscores ($p = 0.02, 0.03$). Increased AROM in shoulder flexion/abduction ($p = 0.02, 0.03$). Enhanced movement accuracy in shoulder external rotation ($p = 0.02$).

RAGT

Greater FMA-LE and total FMA improvements ($p = 0.014, 0.002$). Both groups improved in balance and gait ($p < 0.05$), but differences were not significant. RAGT group retained better motor function at 3 months.

Conclusion

Wearable devices enhance upper limb mobility and precision, while hybrid RAGT improves motor function and gait in subacute stroke patients. Future research should explore long-term effects and personalized rehabilitation strategies.

Keywords: Stroke Rehabilitation, Wearable Devices, Robot-Assisted Gait Training, Motor Recovery

1. Biographical sketch

Name	Position Title
Li-Fong Lin fong930@tmu.edu.tw	**1. Associate professor** School of Gerontology and Long-Term Care, Taipei Medical University, Taiwan **2. Director** Innovation and Entrepreneurship Education Center, Taipei Medical University, Taiwan **3. Physiotherapy** Department of Physical Medicine and Rehabilitation, Shuang Ho Hospital, Taipei Medical University, Taiwan
Web	https://tmu.pure.elsevier.com/zh/persons/li-fong-lin

Institution and Location	Degree	Field of study	Year(s)
Department of Biomedical Engineering, National Yang-Ming University, Taiwan	PhD	Rehabilitation, balance, mild traumatic brain injury, stroke	2006/9~2014/11
Department of Biomedical Engineering, National Yang-Ming University, Taiwan	Master	Rehabilitation, functional magnetic resonance image, stroke	2000/9~2002/7
Department of Physical Therapy, China Medical University, Taiwan	Bachelor	Rehabilitation, Physical Therapy	1994/7~1998/9

2. Research expertise

- Rehabilitation, Physical Therapy, Balance function, Gait analysis, Long-Term Care, Assistive Device

3. Guest Editor

- International Journal of Environmental Research and Public Health (IJERPH) : Special Issue "Advances in Physiotherapy and Rehabilitation"
  https://www.mdpi.com/journal/ijerph/special_issues/2IVCT3UEWJ#published
- Special Issue "Sensing Technology and Wearables for Physical Activity": A special issue of Sensors (ISSN 1424-8220). This special issue belongs to the section "Wearables".

4. Publications (most related)

1. Chang, Pao-Lung, Chen, Kai-Yun, Ou, Ju-Chi, Chiang, Yung-Hsiao, Chen, Hung-Chou, Liou, Tsan-Hon, Escorpizo, Reuben, **Lin, Li-Fong**" Self-reported dizziness, postural stability, and sensory integration after mild traumatic brain injury: A naturalistic follow-up study" Am J Phys Med Rehabilitation 2024 Jan 1;104(1):26-30.
2. Yen-Nung Lin, Shih-ei Huang, Yi-Chun Kuan, Hung-Chou Chen, Wen-Shan Jian, **Li-Fong Lin** "Hybrid robot-assisted gait training for motor function in subacute stroke: a single-blind randomized controlled trial" J Neuroeng Rehabil. 2022 Sep 14;19(1):99.
3. Yi-Chun Kuan, Li-Kai Huang, Yuan-Hung Wang, Chaur-Jong Hu, Ing-Jy Tseng, Hung-Chou Chen, **Li-Fong Lin** "Balance and gait performance in older adults with early-stage cognitive impairment" Eur J Phys Rehabil Med 2021 Aug;57(4):560-567.
4. **Lin LF**, Lin YJ, Lin ZH, Chuang LY, Hsu WC, Lin YH "Feasibility and efficacy of wearable devices for upper limb rehabilitation in patients with chronic stroke: a randomized controlled pilot study." Eur J Phys Rehabil Med. 2018 Jun 54(3):388-396.

Robotics technologies and data analysis to improve elderly care

Yoshio MATSUMOTO[1)]

[1)]Tokyo University of Science

Abstract Body : The Project to Promote the Development and Introduction of Robotic Nursing Care Devices, which started in FY2013, aims to reduce the burden on caregivers and support the independence of the elderly. More than 100 types of robotic nursing care devices were developed in the fields of transfer assistance, transfer support, toileting support, bathing support, and patient monitoring etc, and more than 30 of them have already been commercialized.

It has become clear that the successful use of these robotic nursing care devices can reduce the physical burden of transfers, reduce the burden of nighttime patrols, reduce accidents, and so on. The question is how this will change the role of people, but at present it is difficult to imagine a direction in which people will become unnecessary. Rather, it will reduce physical and mental burdens and allow for safe and efficient work, thereby allowing more time to be spent on “cares that can only be done by people,” such as face-to-face communication. The introduction of such technology will be indispensable in order to survive in a society where the elderly population is increasing and the working population is decreasing.

In addition, people sometimes worry that the use of robotic nursing care equipment will reduce activity and diminish physical functions, but recent analyses of the use of welfare equipment have shown that physical functions can be maintained and improved if the equipment is used properly during daily life. Specifically, our analysis showed that the rate of deterioration of care level reduced and rate of population staying at home increased after five years for walker users of welfare equipment rental service in long-term care system, compared to those who did not use any welfare equipment at all in care level 2.

It is people who use robotic care equipment. In order to realize a society in which the QoL of both caregiving staff and the elderly can be improved through the use of robotic nursing care devices, as mentioned above, the key will be not only the development of the devices themselves but also the collection and sharing of knowledge on their “good practice” within society.

CV

Yoshio Matsumoto is a professor in the Department of Medical and Robotic Engineering Design, Faculty of Advanced Engineering, Tokyo University of Science. He received Ph.D degree in engineering from the University in 1998. He has worked for the Australian National University, Nara Institute of Science and Technology, Osaka University, and National Institute of Advanced Industrial Science and Technology (AIST) before joining Tokyo University of Science in 2023. His research interests include assistive robots, welfare devices, human–robot interaction, and real-time vision.

Skin Status Monitoring for Nursing Care Using Multi-Frequency Impedance Tomography

Sooin KANG[1)], Taketoshi MORI [1,2)]

[1)]Tokyo University of Science, [2)]Japan Agency for Medical Research and Development

Hospital-acquired skin troubles, such as pressure injuries (HAPIs) and PIVC-related complications, have been reported by both nurses and patients. For example, many vascular access devices are removed before the full administration of planned therapy due to adverse events associated with peripheral venous catheters. Failure to promptly remove a peripheral venous catheter in response to these events may lead to peripheral intravenous-related morbidity. A major problem is the lack of a system for early reporting or detection of adverse events, resulting in patients only reporting pain after tissue damage has occurred beneath the skin. For decades, examination tools and skin care protocols have been developed to prevent such incidents, based on patients' characteristics and environmental factors. However, few solutions exist for high-risk individuals beyond frequent care, given the challenges associated with modifying environmental conditions. Therefore, a monitoring tool to support care is essential for reducing the risk of skin troubles in hospitals. Our study introduces a skin impedance monitoring tool that is easily attachable and disposable, with a tomography system designed not to cover the wounds and insertion sites, thereby enabling non-invasive and frequent care. We aim to support intravascular therapy by proposing a monitoring tool for the punctured vein area that estimates vein flow velocity. The system will provide caregivers and patients with information regarding the blood flow status at the PIVC insertion site.

Sooin KANG

Faculty of Advanced Engineering, Tokyo University of Science, Japan

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[Education and work]

2016	Graduated at Department of Biomedical Engineering, Kyunghee University
2017	Research student in Medical School, The University of Tokyo
2018 – 2019	Master course in Graduate School of Medicine and Faculty of Medicine, The University of Tokyo
2018 – 2022	Doctoral course in Global Leadership Initiative for an Age-Friendly Society, The University of Tokyo
2020 – 2022	Doctoral course in Graduate School of Interdisciplinary Information Studies, The University of Tokyo
2021 – 2022	JSPS research fellow（DC2）
2023 -	Assistant professor at Tokyo University of Science
2023 -	Visiting researcher in the University of Tokyo

[Main research area]

Impedance Spectroscopy and Tomography; Biomedical Engineering; Medical Instrumentation; Digital Healthcare

Transcranial Brain Stimulation Approaches for Neuromodulation and Neurorehabilitation: Methods and Potential Applications in Neurological Disorders

Tsung-Hsun Hsieh [1, 2, 3]

[1]School of Physical Therapy and Graduate Institute of Rehabilitation Science, Chang Gung University, Taoyuan, Taiwan

[2]Healthy Aging Research Center, Chang Gung University, Taoyuan, Taiwan

[3]Neuroscience Research Center, Chang Gung Memorial Hospital Linkou, Taoyuan, Taiwan

Transcranial brain stimulation techniques, including transcranial magnetic stimulation (TMS), transcranial direct current stimulation (tDCS), cortical electrical stimulation (CES), and transcranial focused ultrasound (tFUS), have been increasingly explored for neuromodulation. These methods hold significant therapeutic potential for neurological and neuropsychiatric disorders. However, their precise mechanisms and clinical efficacy remain incompletely understood. To bridge this gap, suitable animal models offer a controlled environment to elucidate the underlying mechanisms and optimize therapeutic strategies. In this study, we established various transcranial brain stimulation paradigms using TMS, tDCS, CES, and tFUS in rat models to investigate neuromodulatory effects. We observed that these stimulation protocols induced long-term potentiation (LTP)- and long-term depression (LTD)-like plasticity in rodents, mirroring findings in human studies. Furthermore, we evaluated the therapeutic effects of these interventions in animal models of Parkinson's disease (PD), traumatic brain injury (TBI), and epilepsy. Long-term TMS, tDCS, and CES treatments significantly improved motor and non-motor deficits in PD and TBI rats. In the acute epilepsy model, tFUS effectively suppressed aberrant neuronal activity, highlighting its potential as an anti-epileptic intervention. Our findings provide critical insights into the neuromodulatory mechanisms of transcranial brain stimulation and underscore the value of these animal models in translational research. By bridging preclinical and clinical studies, these models offer a promising platform for refining and developing novel therapeutic strategies for neurological disorders.

BIOGRAPHICAL SKETCH		
Hsieh, Tsung-Hsun	**Professor,** School of Physical Therapy and Graduate Institute of Rehabilitation Science, College of Medicine, Chang Gung University **Director**, The Center for Innovation and Incubation, Chang Gung University	
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EDUCATION

INSTITUTION AND LOCATION	DEGREE	YEAR(s)	FIELD OF STUDY
National Cheng Kung University, Taiwan	Ph.D.	2011	Biomedical Engineering
Chang Gung University, Taiwan	M.S.	2004	Rehabilitation Science
China Medical University, Taiwan	B.S.	2002	Physical Therapy

A. Personal Statement

Dr. Tsung-Hsun Hsieh graduated from the School of Physical Therapy at China Medical University, obtained a master's degree from the Institute of Rehabilitation Science at Chang Gung University, and earned a Ph.D. from the Department of Medical Engineering at National Cheng Kung University. After receiving his Ph.D., he was invited to serve as a postdoctoral research fellow in the Department of Neurology at Harvard Medical School in the United States. Upon returning to Taiwan, he served as an assistant professor at Taipei Medical University, and later, he joined the Department of Physical Therapy and Institute of Rehabilitation Science at Chang Gung University. Now, Dr. Hsieh is a professor and director of the Center for Innovation and Incubation at Chang Gung University. Dr. Hsieh's research has focused on exploring transcranial neuromodulation techniques, including repetitive transcranial magnetic stimulation (rTMS), transcranial direct current stimulation (tDCS), cortical electrical stimulation (CES), temporal interference stimulation (TIS) and transcranial focused ultrasound (tFUS) for neurological diseases through basic and clinical research. His research has resulted in more than 70 publications, including "Brain Stimulation", "Cerebral Cortex", “Journal of NeuroEngineering and Rehabilitation” and other high-impact journals. His current research work focuses on (1) identifying the neuromodulation effects of brain stimulation approaches with various stimulation protocols and exploring novel therapeutics for neurological disorders, and (2) use quantitative electrophysiological measures to detect early pathophysiological changes in conditions such as Parkinson’s disease (PD), traumatic brain injury (TBI) or epilepsy. Moreover, Dr. Hsieh is one of the few scholars in Taiwan capable of integrating the fields of rehabilitation, neuroscience, and biomedical engineering, aiming to make significant contributions to the field of neurorehabilitation science.

B. Positions and Employment

2021/08-Current: Professor, School of Physical Therapy and Graduate Institute of Rehabilitation Science, Chang Gung University

2020/02- Current: Director, The Center for Innovation and Incubation, Chang Gung University

2018/02-2021/07: Associate Professor, School of Physical Therapy and Graduate Institute of Rehabilitation Science, Chang Gung University

2015/02-2018/07: Assistant Professor, School of Physical Therapy and Graduate Institute of Rehabilitation Science, Chang Gung University

2014/03-2015/02: Assistant professor in Graduate Institute of Neural Regenerative Medicine, Taipei Medical University

2012/09-2014/03: Assistant Researcher, Graduate Institute of Neural Regenerative Medicine, Taipei Medical University

2010/05-2012/08: Research Scholar and Postdoctoral Research Fellow, Department of Neurology, Harvard Medical School.

C. Research Interest

Transcranial brain stimulation, Neuromodulation, Electrophysiology, Biomechanics,Systematic Neuroscience, Parkinson’s disease; Traumatic brain injury

Human Modeling and Motion Analysis for Robotic Support

Eiichi YOSHIDA[1)]

[1)] Department of Medical and Robotic Engineering Design, Faculty of Advanced Engineering,
Tokyo University of Science

Human modeling is one of the critical topics in research and development on assistive robots. In this presentation, I will address human modeling using digital actors and human motion reproduction by humanoid robots, together with their application to design of living space and evaluation of assistive devices. We introduce a digital human model integrating its shape and dynamic model to evaluate physical interaction and loads. Some applications for designing furniture and assistive devices are presented. The second topic is reproduction of human motion by a humanoid robot. To what extent can we make the humanoid motions as close as humans' considering intrinsic difference in structure and actuation between humans and robots? We believe posing this question is helpful for human motion understanding. In our approach, we formulated this question as an optimization problem of motion similarity, incorporating geometric morphing and constraints of the human and humanoid. By extracting specific features of hip and knee motions of a lifting task, we contributed to standardization of wearable lumbar support robots.

Eiichi Yoshida received M.E and Ph. D degrees on Precision Machinery Engineering from Graduate School of Engineering, the University of Tokyo in 1996. He then joined former Mechanical Engineering Laboratory, later in 2001 reorganized as National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan. He served as Co-Director of AIST-CNRS JRL (Joint Robotics Laboratory) at LAAS-CNRS, Toulouse, France, from 2004 to 2008, and at AIST, Tsukuba, Japan from 2009 to 2021. He was also Deputy Director of Industrial Cyber-Physical Systems Research Center, and TICO-AIST Cooperative Research Laboratory for Advanced Logistics in AIST from 2020 to 2021. In 2022 he moved to Tokyo University of Science (TUS), and is currently Professor at Department of Medical and Robotic Engineering Design, Faculty of Advanced Engineering of TUS. He is IEEE Fellow, and a member of RSJ, SICE and JSME. He has published more than 200 scientific papers in journals and peer-reviewed international conferences and co-edited some books. He received several awards including Best Paper Award in Advance Robotics Journal and the honor of Chevalier l'Ordre National du Mérite from French Government. His research interests include robot task and motion planning, human modeling, humanoid robotics and advanced logistics technology.

Day 1 Sat. March 8th, 2025

16:00-17:15

Session D. Photonics & Imaging

Chairs:

Prof. Kohei SOGA (TUS) /

Prof. Tsung-Rong KUO (TMU)

Optical Mapping Applications in Langendorff-Perfused Heart Studies

Chu Ling Chang [1)], Yen Ling Sung [2)]

[1)] School of Medicine, College of Medicine, Taipei Medical University, Taipei, 110301, Taiwan, [2)]Graduate Institute of Biomedical Optomechatronics, College of Biomedical Engineering, Taipei Medical University, New Taipei City, 235603, Taiwan

Cardiac optical mapping has emerged as a pivotal tool for investigating complex electrophysiological phenomena with unparalleled spatial and temporal resolution. This technique provides insights into conduction dynamics and arrhythmogenic mechanisms that conventional electrical mapping cannot fully resolve. This presentation will detail an ex vivo optical mapping protocol optimized for high-resolution electrophysiological studies. Key methodological considerations include the use of voltage-sensitive dyes for action potential tracking and blebbistatin to suppress contractile interference, ensuring precise signal acquisition. Through optical mapping, we achieve a refined understanding of cardiac conduction abnormalities associated with genetic predispositions and environmental stressors, thereby advancing translational approaches in arrhythmia research and cardiovascular risk assessment.

This presentation will also highlight the application of optical mapping in Langendorff-perfused heart studies, particularly in modeling genetic and environmental factors contributing to arrhythmogenesis. Recent findings suggest that the East Asian-specific aldehyde dehydrogenase 2 (ALDH22) deficiency exacerbates alcohol-induced arrhythmogenic risk, even at light-to-moderate alcohol consumption levels. Using an ALDH22 knock-in (KI) mouse model, optical mapping has revealed significant electrophysiological alterations, including QT prolongation, reduced connexin43 expression, and ion channel dysregulation, leading to increased ventricular arrhythmia susceptibility. Programmed electrical stimulation further confirms the heightened propensity for rotor formation and sustained arrhythmic episodes in ethanol-treated ALDH2*2 KI hearts.

Yen-Ling Sung received the B.S. degree from the Department of Biotechnology, Kaohsiung Medical University, Kaohsiung, Taiwan, in 2014, and the Ph.D. degree from the Department of Electrical and Computer Engineering, National Chiao Tung University, Hsinchu, Taiwan, in 2020. She served as a Post-Doctoral Researcher for advanced biomedical imaging system developments in cardiac electrophysiology with National Taiwan University Hospital, Taipei City, Taiwan; Cedars Sinai Medical Center, Los Angeles, CA, USA; and National Tsing Hua University, Hsinchu, Taiwan, from 2020 to 2022. She is currently an Assistant Professor at the Graduate Institute of Biomedical Optomechatronics, Taipei Medical University, Taipei City, Taiwan. Her research interests include biomedical devices, biomaterials, optogenetic therapy, and cardiac electrophysiology.

Photonics and Imaging for Supporting Human Function

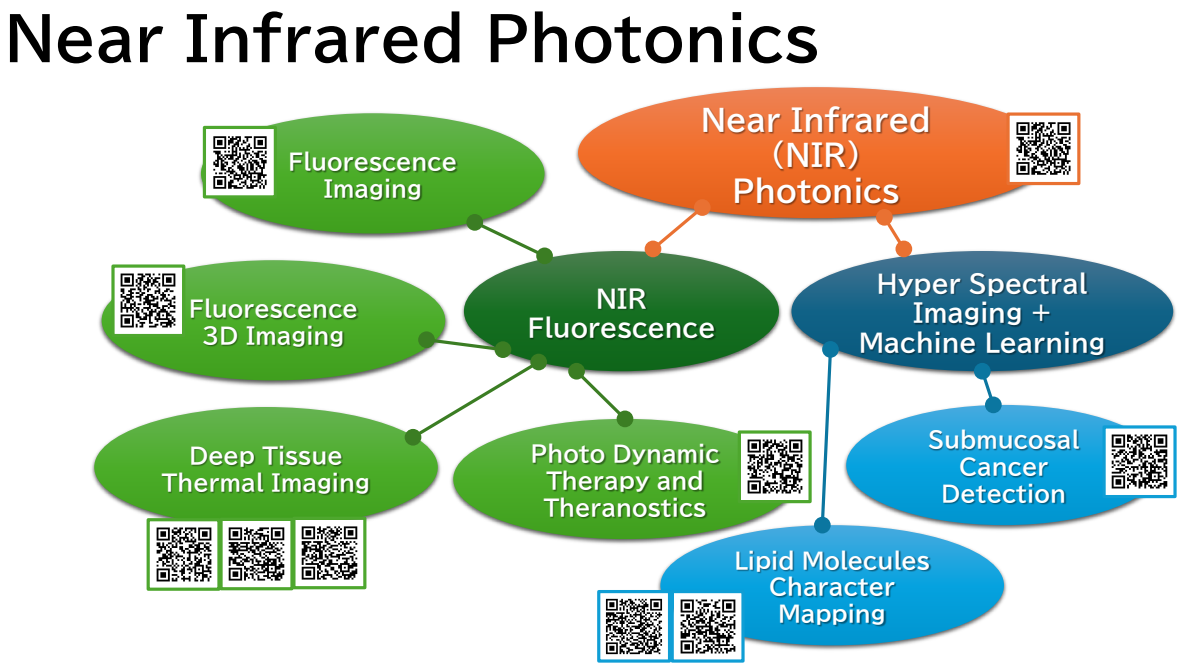
Kohei SOGA[1, 2)]

[1]Department of Medical and Robotic Engineering Design, Tokyo University of Science, Tokyo, Japan

[2]Risearch Institute for Biomedical Sciences, Tokyo University of Japan, Chiba, Japan

Near infrared (NIR) light is known as the most transparent light among the lights with wavelengths around the visible light. Our group has been working on the applications of the NIR light since 2005 and summarized them together with the fundamentals of the NIR light in a book [1]. The most representative application of photonics for biomedical application is fluorescence imaging for clarifying phenomena or medical diagnosis. For some cases, the fluorescence from a deep part of a body can be observed from a centimeter below the skin. The brain blood vessel can be observed without removing the skin and skull. Of course, fluorescence is normally used for revealing the existence of a certain matter. Some of more interesting recent applications are to reveal information of the location or the substance. In this talk, some of the interesting application of the near infrared photonics for the biomedical application will be reviewed.

[1] K. Soga et al. ed., "Transparency in Biology, -making invisible visible-," (2021, Springer). https://doi.org/10.1007/978-981-15-9627-8



K. Soga et al. ed., "*Transparency in Biology ~Making Invisible Visible~*" (Springer, 2021) https://www.springer.com/jp/book/9789811596261

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Prof. SOGA attracts to research relating to photonics, bioimaging, especially those relating to diagnosis and medical applications. Driven by the desire to observe the deeper region of the intricacies of biological systems, he has been challenged to develop bio-photonic systems under short-wave infrared (SWIR) excitation since 2004. SWIR light is located between the visible and (mid) IR wavelength range, where a valley is formed in optical loss spectra of biological tissues. By utilizing this SWIR transparent wavelength range for bio and medical photonics, he could take advantage of transparency. He is an inventor for various SWIR bioimaging systems and probes. The advent of this technique has the potential to revolutionize our understanding of fundamental physiological processes and pave the way for innovative interventions in fields such as oncology, neurology, and regenerative medicine.
Website: https://ksoga.com/soga/

Subnanocluster CuOx on TiO2 for Photocatalytic Nitration Reduction Reactions with In-situ XAS Analysis

Chia-Che Chang [1)]

[1)]National Synchrotron Radiation Research Center

The Haber-Bosch process is widely used for ammonia (NH_3) production; however, it requires significant energy consumption and yields substantial carbon dioxide (CO_2) emissions. Developing a more sustainable alternative with lower CO_2 emissions is essential research. Photochemical nitrate reduction reaction (NtRR) to ammonia provides the benefit, of addressing nitrate pollution in the water while supplying a more environmentally friendly approach to ammonia synthesis. In this work, subnanometer-sized copper oxide (CuO_x) clusters were successfully synthesized and decorated on titanium dioxide (TiO_2) nanoparticles using a hydrothermal method followed by calcination treatment. The CuO_x-TiO_2 catalyst exhibited an impressive nitrate-to-ammonia conversion efficiency, achieving a yield of 153.09 $\mu g \cdot g^{-1} \cdot h^{-1}$ in a potassium nitrate (KNO_3) solution. The structural analysis confirmed that CuO_x clusters with ~less than 1 nm were effectively dispersed on the TiO_2 nanoparticles. Using in-situ X-ray absorption fine structure (XAFS) spectroscopy, we observed changes in the oxidation state and local structural dynamics of Cu clusters during the reaction. Additionally, the photocatalytic mechanism underlying nitrate reduction on CuO_x-TiO_2 was elucidated. These findings have significant implications for facilitating the function of catalysts through subnanometer-sized cluster engineering. Our research contributes to developing next-generation ammonia synthesis methods that use less energy and produce fewer carbon emissions.

Dr. Chia-Che Chang received his PhD degree in chemistry from Tunghai University in 2023 and then worked as a postdoctoral fellow at the National Synchrotron Radiation Research Center, Taiwan. His research interests focus on preparing nanomaterials for catalytic ammonia synthesis from electricity and photons. He further confirmed the mechanism of the dynamic catalytic process using the technique of in-situ X-ray absorption fine structure spectroscopy in NSRRC.

Polymer design for cancer gene therapy and nanostructure probing

Kensuke OSADA

Institute for Quantum Medical Science,

National Institutes for Quantum Science and Technology (QST), Japan

Atoms make everything. This fact means if atoms are connected to prepare molecules and polymers, and assemblies over several hierarchies in right way, life emerges. Theoretically true, but it seems too challenging to reproduce this process using synthetic chemistry. However, it may still be possible to construct a structure that is hierarchically one level before life.

With this hope in mind, we designed primary structure of polymers and assemble them with DNA to produce a structure looked like virus. The constructed structure packaged a single DNA molecule inside its capsid-like shell with 100 nm size to form a polyplex micelle, permitted protein production from the packaged DNA in cultured cells and in mice, and demonstrated therapeutic effect in cancer model mice by systemic application.[1] Gene therapy to fibrotic cancer, such as pancreatic cancer, was nevertheless challenging because the presence of fibrous stroma surrounding the cancer cells hamper the access of 100 nm-sized polyplex micelles. The size has to be reduced so that polyplex micelles can penetrate stroma to access tumor cells. To this end, we managed the intrinsic rigidity of DNA to prepare size-minimized polyplex micelles, which permitted access to the tumor cells and demonstrated significant antitumor effict.[2]

These studies suggest that study to elucidate tumor structure in nanoscale is indispensable for the more effective utilization of nanomedicines. In this regard, a size-tuned polymer based on graft copolymer is attractive.[3] The hydrodynamic size can be adjusted from a few nanometers to 10s of nanometers by modulating the number or molecular weight of PEG to be grafted. The polymer allows for predicting the penetration potential of nanomedicines of interest by adjusting its size so. Antibodies are among the most highly regarded nanomedicines, as seen in antitumor drug conjugate, immune checkpoint inhibitors, and targeted radionuclide therapy. Thus, the polymer with its size adjusted to antibody and conjugated with contrast agents visualized tumor nanostructures in a patient derived tumor xenograft (PDX) model mouse by MRI. The coupling of this polymer and MRI would be a tool to probe nanostructures in the body and predict the accessibility of nanomedicines in a non-invasive manner.

Kensuke OSADA

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Kensuke OSADA is a Group Leader and Senior Principal Investigator in the Department of Molecular Imaging and Theranostics, Institute for Quantum Medical Science, National Institutes for Quantum Science and Technology (QST) Japan. He obtained his PhD at the Department of Organic and Polymeric Materials, Tokyo Institute of Technology, in 2002. In 2003 he was a postdoctoral fellow at the Tokyo Institute of Technology, and in 2004, he completed his postdoctoral work with Prof. Kazunori Kataoka at The University of Tokyo. From 2004 to 2006, Dr. Osada was a Project Assistant Professor at the Department of Materials Engineering, Graduate School of Engineering, The University of Tokyo, where he was promoted to a Project Associate Professor in 2006. During 2012-2016, he was a PRESTO researcher by the Japan Science and Technology Agency (JST). He also became a Project Associate Professor at the Department of Bioengineering, Graduate School of Engineering, The University of Tokyo in 2013, until he moved to his position at QST in 2018. He has received several awards, including the Award for Encouragement of Research in Polymer Science, and the Award of Asahi kasei from the Japanese Society of Polymer Science and the Award for Encouragement of Research from the Japan Association for Chemical Innovation.

His research interest includes complex coacervates from synthetic and biological polymers and their application as nanomedicines. In particular, the nanoassembly structure constructed from synthetic polymers and DNA prepared as a synthetic virus by him have demonstrated therapeutic effect in intractable cancer, such as pancreatic cancer. His interests are further extended to development of MRI nanoprobes to diagnose diseases and nanodiamonds to probe biophysical information in body as a quantum sensor. His standpoint is to clarify physics and structures of nanoparticle formation underlying and to strategically design polymers so that the finest performance can be emerged there for diagnosis and therapy.

Plasmonic Nanoisland Substrate for Bacterial Theranostics

Tsung-Rong Kuo[1]

[1]Graduate Institute of Nanomedicine and Medical Engineering, College of Biomedical Engineering, Taipei Medical University, Taipei 11031, Taiwan

Plasmonic metal nanomaterials have garnered significant attention for their applications in biomedical sensing and treatment. This study focuses on plasmonic silver nanoisland films (AgNIFs), which were effectively synthesized on a glass substrate using a seed-mediated growth method. The nanostructure of AgNIFs was characterized with techniques such as scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX), and atomic force microscopy (AFM). The UV-Vis spectra of the AgNIFs displayed a broad absorption range from 300 to 800 nm due to surface plasmon resonance. Under simulated sunlight, the temperature of the optimal AgNIF rose to 66.9 °C, suitable for photothermal bacterial eradication. Additionally, AgNIFs maintained a reliable photothermal response under cyclic light exposure. For photothermal therapy, these films showed high efficacy in eradicating Escherichia coli (E. coli) and Staphylococcus aureus (S. aureus). The distinctive nanoisland structure enhanced bacterial growth compared to a bare glass substrate. Furthermore, AgNIFs were validated as a surface-enhanced Raman scattering (SERS) substrate, effectively amplifying Raman signals of E. coli and S. aureus. By combining photothermal therapy and SERS detection, AgNIFs present a promising platform for bacterial theranostics.

Dr. Tsung-Rong Kuo received his PhD degree in Chemistry from the National Taiwan Normal University in 2011 and then worked as a postdoctoral fellow at the Institute of Atomic and Molecular Sciences, Academia Sinica, Taiwan and the Department of Chemistry at University of California (Berkeley). In 2015, he joined the Graduate Institute of Nanomedicine and Medical Engineering at Taipei Medical University as an assistant professor and was promoted to professor in 2022. Currently, he is the director in International Ph.D. Program in Biomedical Engineering and Graduate Institute of Nanomedicine and Medical Engineering at Taipei Medical University. His recent research interests focus on preparations of nanomaterials including metals, metal oxides and semiconductors for the applications in nanomedicine and energy conversion.

Day 2 Sun. March 9th, 2025

10:00-11:15

Session E. Medicals

Chairs:

Prof. Hidehiro KISHIMOTO (U. Ryukus) /

Prof. Jiunn-Horng KANG (TMU)

Design and Development of Novel Brain Neuromodulation Technology for Neuro-Rehabilitation

Chih-Wei Peng[1]

[1)] **School of Biomedical Engineering, Taipei Medical University**

Abstract Body：

In recent years, due to the mature development of microelectromechanical systems (MEMS) technology and rapid advancements in basic neuroscience research, numerous neuromodulation technologies and devices based on electrical stimulation have been widely developed and applied clinically. These aim to address various chronic neurogenic disorders caused by brain injury or degeneration. The current trends in brain electrical neuromodulation technology can generally be categorized into two major types: invasive and non-invasive. Invasive techniques primarily center around deep brain stimulation (DBS). Non-invasive approaches include three main technologies: the well-established repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS), along with the recently emerging transcranial temporal interference stimulation (tTIS). Compared to invasive DBS, tTIS avoids the risks associated with cranial surgery for electrode implantation while effectively targeting deep brain regions beneath the cortical layer. It presents as a breakthrough and forward-looking approach in neurorehabilitation, offering a novel treatment modality with potential academic research value due to the limited current literature. Additionally, it holds promise for clinical applications in treating various neurodegenerative diseases, making it a worthwhile focus for further development. In this talk, I would like to share our experience in the proactive development of brain stimulation devices, and their feasibilities for various clinic applications.

Title: Professor and Director

Speaker/Affiliation: Chih-Wei Peng (彭志維 博士) /School of Biomedical Engineering, Taipei Medical University

E-mail: cwpeng@tmu.edu.tw

Bio：

Professor Chih-Wei Peng received the B.S. degree in Physical Therapy from Chang Gung University, and the M.S. and Ph.D. degrees in Biomedical Engineering from National Cheng Kung University, Taiwan. He was a visiting scholar in Duke University in 2006-2007. He is currently a full Professor and Chairman of the School of Biomedical Engineering and a full professor of Physical Medicine & Rehabilitation, and the deputy director of Research Center of Rehabilitation Engineering and Assistive Technology, Taipei Medical University. Currently, he works for more than 10 international journals as reviewers, which covering physical therapy, neural rehabilitation, assistive technology, rehabilitation engineering, neuroscience, brain stimulation, medical engineering, and neural engineering.

Selected Peer Reviewed Papers in Recent Three Years

[1] Bayu Tri Murti, Yi-June Huang, Athika Darumas Putri, Chuan-Pei Lee, Chien-Ming Hsieh, Shih-Min Wei, Meng-Lin Tsai, Chih-Wei Peng*, Po-Kang Yang (2022, Sep). Free-Standing Vertically Aligned Tin Disulfide Nanosheets for Ultrasensitive Aptasensor Design toward Alzheimer's Diagnosis Applications. Chemical Engineering Journal. (Accepted) (IF= 16.744, SCI, 4/142 =2.8%,).

[2] Yi-Jing Huang, Shun-Min Wang, Chieh Chen, Chien-An Chen, Chun-Wei Wu, Jia-Jin Chen, Chih-Wei Peng, Che-Wei Lin, Shih-Wei Huang, Shih-Ching Chen (2022, Sep). High-definition Transcranial Direct Current with Electrical Theta Burst on Post-stroke Motor Rehabilitation: A Pilot Randomized Controlled Trial. Neurorehabilitation and Neural Repair. 36(9):645-654. (IF= 4.895, 6/68=8.8%).

[3] Muhammad Adeel, Bor-Shing Lin, Hung-Chou Chen, Chien-Hung Lai, Jian-Chiun Liou, Chun-Wei Wu, Wing P Chan, Chih-Wei Peng* (2022, Aug). Motor Neuroplastic Effects of a Novel Paired Stimulation Technology in an Incomplete Spinal Cord Injury Animal Model. Int J Mol Sci. 2022 Aug 21;23(16):9447. (IF= 6.208, SCI, 69/296=22.6%)

[4] Shuo-Wen Chen, Shih-Min Huang, Han-Song Wu, Wei-Pang Pan, Shih-Min Wei, Chih-Wei Peng, I-Chih Ni,Bayu Tri Murti ,Meng-Lin Tsai, Chih-I Wu, Po-Kang Yang (2022, Aug). A Facile, Fabric Compatible, and Flexible Borophene Nanocomposites for Self-Powered Smart Assistive and Wound Healing Applications. Advanced Science. 9(22):e2201507. doi: 10.1002/advs.202201507. (IF=16.806, 18/334=5.4%)

[5] Z Zhang, BS Lin, CW Wu, TH Hsieh, JC Liou, YT Li, CW Peng* (2022 May). Designing and Pilot Testing a Novel Transcranial Temporal Interference Stimulation Device for Neuromodulation. IEEE Transactions on Neural Systems and Rehabilitation Engineering. 30:1483-1493.doi:10.1109/TNSRE.2022.3179537. (IF=4.528, SCI, 10/68 =14.7%).

[6] SM Wang, YJ Huang, JJJ Chen, CW Wu, CA Chen, CW Lin, VT Nguyen, CW Peng* (2021, Sep). Designing and Pilot Testing a Novel High-Definition Transcranial Burst Electrostimulation Device for Neurorehabilitation. Journal of Neural Engineering 18(5).(IF=5.034, 32/98=22.2%)

Hijacking of eukaryotic proteolytic pathways by the bacterial pathogen "Leptospira" to disassemble epithelial cell junctional complexes

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Leptospirosis is a widespread bacterial zoonosis and one of the most important acute febrile infectious diseases in tropical and subtropical regions, which is difficult to differentiate from other infectious diseases common in these regions. Leptospirosis is endemic to Okinawa prefecture, the southernmost prefecture of Japan, where the infection occurs mainly after recreational activities in rivers in the northern part of Okinawa Main Island and the Yaeyama region.

Pathogenic *Leptospira* spp. colonize the renal proximal tubules of reservoir hosts and are shed in the urine, contaminating the environment. Their ability to survive in water and soil, and infect a wide range of host species, including humans and wild and domestic animals, has made leptospirosis a zoonotic disease of increasing importance. Upon infection, leptospires can traverse tissue barriers to rapidly disseminate to all organs. The destruction of these physical barriers requires the disassembly of the cell junctional complexes (JCs), which are located at the lateral sides of the cell membrane. E-cadherin is a membrane protein that function as a master organizer of the JCs and, thus, the epithelial barrier function.

Our research group combined proteomic and imaging analysis with chemical inhibition studies to demonstrate that *Leptospira* induces E-cadherin endocytosis and cytoskeletal disruption during renal epithelial cells infection. This E-cadherin mislocalization allows the opening of cell-cell junctions and facilitates bacterial adherence to the cell membrane to establish the infection. Elucidation of the detailed mechanisms of these pathogenic strategies will guide new approaches to developing vaccines and diagnostic method.

In this symposium, I'll introduce how hijacking eukaryotic cell degradation pathways (proteasomal and lysosomal) allows *Leptospira* to induce the destruction of the cell barrier integrity. Furthermore, I'll discuss the leptospiral strategy to disassemble the JCs by targeting armadillo repeat-containing proteins (p0071 and p-120 catenin) which are important for E-cadherin plasma membrane localization.

CLAUDIA TOMA, PhD

Associate Professor

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Graduate School of Medicine, Department of Bacteriology

Claudia Toma obtained her Bsc degree in Biochemistry in 1992 from the University of Buenos Aires (Argentina) and completed her PhD in 1999 at the University of the Ryukyus, where she became Assistant Professor in 2000. Her first research focused on understanding pathogenic mechanisms of the intestinal pathogens *Vibrio cholerae* and Shiga-toxin producing *Escherichia coli.* She also focused on the multiple-antimicrobial resistance mechanisms of *V. cholerae* in collaboration with the Center for Laboratory and Epidemiology (Lao PDR) and the National Institute of Hygiene and Epidemiology (Vietnam). She further collaborated in several Projects to understand the innate immune response during *Vibrio* infection, elucidating the mechanism of the inflammasome activation by *V. vulnificus*, *V. cholerae* and *V. parahaemolyticus* (collaborations with the University of Michigan and Osaka University).

In 2007, she started as a PI in the Department to study leptospirosis because of its importance in Okinawa. Her first study as PI focused on the mechanism of macrophage infection by *Leptospira*. Currently, she has expanded her interests to pathogenic mechanisms, eco-epidemiology and diagnosis. In collaborations with Tohoku University, Okinawa Institute of Science and Technology (OIST), University of Peradeniya (Sri Lanka) and the Okinawa Prefectural Institute of Health and Environment, several projects are ongoing including:

- *Mechanisms of renal proximal tubule epithelial cells infection*
- *Understanding of Leptospira eco-epidemiology using DNA metabarcoding*
- *Development of a point of care diagnostic test for leptospirosis* (Japanese Patent No. 6979200)
- *Disruption of epithelial cell mechanosensing during Leptospira infection*

SELECTED PUBLICATIONS

1. Tokumon R, Sebastián I, Humbel BM, Okura N, Yamanaka H, Yamashiro T, **Toma C**. Degradation of p0071 and p120-catenin during adherens junction disassembly by *Leptospira interrogans*. ***Frontiers in Cellular and Infection Microbiology***, 2023, 13: 1228051.
2. Sato Y, Hermawan I, ...**Toma C**. Analysis of human clinical and environmental *Leptospira* to elucidate the eco-epidemiology of leptospirosis in Yaeyama, subtropical Japan. ***PLOS Neglected Tropical Diseases*****,** 2022, 16 (3): e0010234.
3. Sebastián I, Okura N, Humbel BM, Xu J, ...Yamashiro T, Nakamura S, **Toma C.** (2021) Disassembly of the apical junctional complex during transmigration of *Leptospira interrogans* across polarized renal proximal tubule epithelial cells. ***Cell Microbiology***, Sep;23(9): e13343.
4. Yamaguchi T, ..., **Toma C**. (2018) Characterizing interactions of *Leptospira interrogans* with proximal renal tubule epithelial cells. ***BMC Microbiology*** 18: 64.

Is low neural hormone a culprit of sarcopenia?

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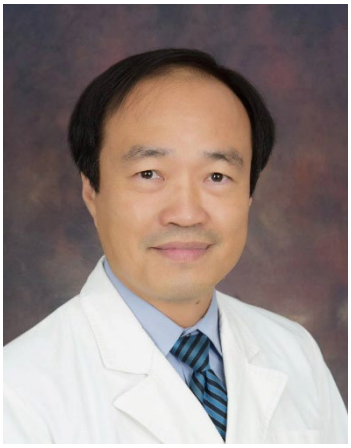
Aging affects body composition, including a decrease in skeletal muscle mass. Sarcopenia, characterized by gradual reduction in muscle mass and muscle strength, leads to reduced mobility, fragility and loss of independence. Sarcopenia is secondary to several factors such as sedentary lifestyle, inadequate nutrition, chronic inflammatory state and neurological alterations. Sarcopenia may related with the hypothalamic-pituitary-adrenal axis, affecting neurotransmitter and hormone levels. However, the association between sarcopenia and these markers, particularly in comparison to non-sarcopenic controls, is understudied. Additionally, the effects of exercise and nutritional support on neurotransmitter levels in sarcopenic patients are largely unknown. This report explores these neurochemical changes and their response to therapeutic interventions.

This post-hoc analysis of a randomized controlled trial included 57 sarcopenic and 57 non-sarcopenic participants from the same cohort. Grip strength and body composition were measured. Sarcopenic patients received a 12-week intervention involving resistive exercise and supplementation with branched-chain amino acids, calcium, and vitamin D3. Serum Plasma adrenaline, noradrenaline, dopamine, serotonin, and cortisol were assessed using enzyme-linked immunosorbent assay. Sarcopenic individuals had significantly lower levels of serotonin ($p=0.002$), adrenaline ($p<0.001$), and noradrenaline ($p<0.001$), with a trend toward reduced dopamine ($p=0.053$). Cortisol levels were similar between groups ($p=0.503$). Generalized estimating equations, adjusted for age and gender, showed sarcopenia was linked to reduced serotonin, adrenaline, and noradrenaline, while the intervention raised noradrenaline levels ($p=0.001$).

Sarcopenic patients exhibit lower serotonin, adrenaline, and noradrenaline compared to non-sarcopenic controls, with no significant difference in cortisol levels. Exercise and nutritional interventions increased noradrenaline in sarcopenic individuals. Further studies are needed to evaluate long-term effects on neurotransmitter and hormone levels.

Curriculum Vitae



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POSITION TITLE:

- Medical Director, National Taiwan University Hospital Beihu Branch.
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- Director, Taiwan Osteoporosis Association
- Director, Taiwan Society of Neurorehabilitation
- Director, Taiwan Academy of Physical Medicine and Rehabilitation
- Education Committee, International Society of Physical and Rehabilitation Medicine

EDUCATION

1995-2000: MD, College of Medicine, Kaohsiung Medical University, Taiwan

2004-2011: PhD, Graduate Institute of Clinical Medicine, National Taiwan University, Taiwan.

2018-2020: EMBA, Division of International Business, College of Management, National Taiwan University, Taiwan.

FIELD OF SPECIALTY

Dr. Han's research interests are on muscle biology, sarcopenia, exercise and fitness, molecular biology, and geriatric rehabilitation. He has published over 100 research articles in the related fields.

SELECTED PUBLICATION:

1. Hsu WH, Wang SY, Chao YM, Chang KV, Han DS, Lin YL. Novel metabolic and lipidomic biomarkers of sarcopenia. Journal of Cachexia, Sarcopenia and Muscle 2024;.https://doi.org/10.1002/jcsm.13567
2. Antoniadou E, Giusti E, Capodaglio P, Han DS, Gimigliano F, Guzman JM, Oh-Park M, Frontera W. Frailty Recommendations and Guidelines. An evaluation of the implementability and a critical appraisal of clinical applicability by the ISPRM Frailty Focus Group. Eur J Phys Rehabil Med. 2024 4 June;60(3):530-9.
3. Lee SY, Chao CT, Han DS, Chiang CK, Hung KY. A combined circulating microRNA panel predicts the risk of vascular calcification in community-dwelling older adults with age strata differences. Archives of Gerontology and Geriatrics 2024 Jan 15:120:105333.
4. Peng LN, Chan DC, Han DS, Lee CY, Lei HJ, Lin WY, Liu TH, Pan HJ, Wu CH, Yen CH, Chen LK, and the Taiwan Advisory Panel for Sarcopenia (TAPS). Advancing Sarcopenia Diagnosis and Treatment: Recommendations from the Taiwan Advisory Panel for Sarcopenia. Aging Medicine and Healthcare 2024..
5. Chang K, Wu W, Chen Y, Chen L, Hsu W, Lin Y, Han D. Enhanced serum levels of tumor necrosis factor-α, interleukin-1β, and -6 in sarcopenia: alleviation through exercise and nutrition intervention. Aging (Albany NY). 2023 Nov 29; 15:13471-13485 . https://doi.org/10.18632/aging.205254

Altered gut microbiota by antibiotics administration ameliorates experimental cerebral malaria in C57BL/6N mice

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Malaria caused by protozoa of the genus *Plasmodium* is one of the most prevalent infectious diseases in tropical and subtropical regions. Gastrointestinal symptoms such as abdominal pain, vomiting, and diarrhea are frequently observed in malaria patients in addition to the malarial triad of fever, anemia, and splenomegaly. We previously reported that C57BL/6N (B6) mice infected with *P. berghei* ANKA (PbA) showed intestinal pathology associated with remarkable changes in microbiota. However, the association between gut microbiota and malarial pathogenesis is poorly understood. In this study, the effects of gut microbiota on malarial pathogenesis using B6 mice modified gut microbiota by antibiotics (AB) were examined. Male B6 mice that were administrated drinking water containing AB (Ampicillin, Neomycin, Metronidazole, and Vancomycin) for 2 weeks and infected with PbA were used for the experiments. AB-treated mice had markedly changed the composition of fecal microbiota in 2 weeks after administration and during infection. Notably, 70 - 80% of AB-treated B6 mice with PbA infection avoided experimental cerebral malaria (ECM) and died with high parasitemia 4 weeks after infection. Infection of AB-treated mice significantly decreased the leakage of Evans blue dye and accumulation of white blood cells including CD8T cells in the brain at 7 days after infection, which suggests the amelioration of ECM. Furthermore, the analysis of 16S rRNA gene amplicon sequencing revealed that some species of microbiota correlate with ECM development. These results suggested that gut microbiota affects ECM pathogenesis following PbA infection.

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Apr 2022-Present	Assistant Professor, Department of Immunology and Parasitology, Graduate School of Medicine, University of the Ryukyus, Japan.

Education:

2009	PhD, Immunobiology Group, Division of Infection Immunobiology, Department of Molecular and Cellular Biology, Graduate School of Medicine, University of the Ryukyus, Okinawa, Japan.
2006	MS, Department of Immunology, Graduate School of Medical and Dental Sciences, Niigata University, Niigata, Japan.
2004	BS, Department of Chemistry, Biology and Marine Sciences, Faculty of Science, University of the Ryukyus, Okinawa, Japan.

Professional experience (selected):

Apr 2020- Mar 2022	JSPS Restart Postdoctoral Fellow, Laboratory of Functional Genomics, Department of Infection and Immunity, National Research Center for Protozoan Diseases, Obihiro University of Agriculture and Veterinary Medicine, Japan.
Sep 2019-Mar 2020	Assistant Professor, Virtual Human InformatiX (V-iCliniX), Nara Medical University, Japan.
Jul 2011-Aug 2019	Assistant Professor, Center for Medical Education and Department of Parasitology, Graduate School of Medicine, Gunma University, Japan.
Apr 2011-Jun 2011	Research Student of Graduate School of Medical and Dental Sciences, Niigata University, Japan.
Apr 2009-Mar 2011	JSPS Postdoctoral Fellow, Laboratory of Hematology and Oncology, Division of Medical and Technological Sciences, Graduate School of Health Sciences, Niigata University, Japan.

Major research interests:

1. The influence of host-microbe interaction on malaria pathogenesis and severity
2. The mechanisms of acquiring natural immunity to malaria, and persistent malaria infection
3. Cell-cell communication using extracellular vesicles such as plasma micro particles and exosomes in malaria patients

Other experience:

- Malaria field survey in Uganda and Lao PDR
- Have published more than 30 papers, and 100 presentations on Immunology and Parasitology

Development of an exoskeletal rehabilitation robot: the MirrorHand

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Robotic-assisted rehabilitation has become a global trend in recent years in the field of rehabilitation medicine. Among the most challenging issue for post-stroke rehabilitation is upper limb and finger rehabilitation. To address this, a collaborative research team comprising the Dept of Physical Medicine and Rehabilitation, Chang Gung Memorial Hospital at Linkou, School of Medicine, Chang Gung University, and the Department of Mechanical Engineering at National Tsing Hua University embarked on a technology-assisted project funded by the Ministry of Science and Technology.

Our successful endeavor developed an innovative wearable hand exoskeleton specifically designed for stroke patients' finger rehabilitation. This exoskeleton incorporates a virtual rotational center axis and features a three-finger joint structure, aligning with individual rotational centers. The power transmission mechanism employs a traction-based drive, enabling independent finger movements for extension and flexion. Additionally, the device integrates sensor technology to detect variations in hand posture for stroke patients, thereby controlling the exoskeleton applied to the affected hand.

The project has not only led to the creation of a next-generation exoskeleton but has also spined off a startup company that transforms this technology into a product, the Mirror Hand, for clinical use. The Mirror Hand has been approved by FDA in many countries, such as Taiwan, USA, and Malaysia. Robotic rehabilitation is becoming the mainstream for post-stroke neurorehabilitation. This talk will share the development experiences from academia to the challenge of entrepreneurship, encouraging different professionals to actively engage in medical innovation and application.

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Professional Affiliations:

Director, Taiwan Academy of Physical Medicine and Rehabilitation

Director, Taiwan Society of neurorehabilitation

Vice Chairman, Medical Design Association

Education and Professional Experiences:

1999- Physiatrist in Department of Physical Medicine and Rehabilitation, Chang Gung Memorial Hospital at Linkou, Taoyuan, Taiwan

2005-2009 PhD Program of Neuroscience, School of Medicine, Johns Hopkins University, Baltimore, USA

2018-2024 Director, Department of Physical Medicine and Rehabilitation, Chang Gung Memorial Hospital at Linkou, Taoyuan, Taiwan

2024- Professor and Attending Physician, Department of Physical Medicine and Rehabilitation, Chang Gung Memorial Hospital at Linkou, Taoyuan, Taiwan

Biography:

Dr. Pei's research focuses on understanding how tactile features, such as tactile orientation or motion, are represented in the primary somatosensory cortex. Using rodent and primate models, his team characterizes the neural codes underlying the non-linear processing of tactile features as the information ascends along the processing hierarchies. This understanding is further applied in the development of rehabilitation robots which have been approved by FDA and applied clinically for patients with neurological disorders.

Selected Publications

Huang JJ, …, Pei YC*. Therapeutic effects of powered exoskeletal robot-assisted gait training in inpatients in the early stage after stroke: a pilot case-controlled study. Journal of NeuroEngineering and Rehabilitation 21, (1), 1-13, 2024.

Pu SW, et al. Decoupling Finger Joint Motion in an Exoskeletal Hand: A Design for Robot-assisted Rehabilitation. IEEE transactions on industrial electronics. 2020 Jan. 67(1) 686-697.

Pei Y, et al. Neural mechanisms of tactile motion integration in primary somatosensory cortex. Neuron. 2011; 69(3):536-547.

Pei Y, et al. Shape invariant coding of motion direction in primary somatosensory cortex. PLoS Biology. 2010;8(2):e1000305.

Pei Y, et al. The tactile integration of local motion cues is analogous to its visual counterpart. Proc Natl Acad Sci USA. 2008 Jun 10;105(23):8130-5.