CONFERENCE ABSTRACT

2023 International Conference on Computer Graphics and Image Processing (CGIP 2023)

January 13-16, 2023

Tokyo, Japan

Organized by

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Welcome Letter

Dear distinguished delegates,

On behalf of the organizing committee, I would like to express my sincere welcome to all of you for participating in 2023 International Conference on Computer Graphics and Image Processing (CGIP 2023). CGIP 2023 will be held during January 13-16, 2023 in Tokyo, Japan in hybrid mode with online and offline. CGIP is an annual conference which aims to present the latest research and results of scholars and experts related to Computer Graphics and Image Processing. This conference provides opportunities for delegates from different areas to exchange new ideas, applications and experiences face to face, to establish business or research relations, and to find global partners for future collaboration.

We are glad to receive more than 130 submissions from all over the world and 69 papers are accepted to be presented in the conference. Thanks for their great efforts and excellent works. The conference will include 4 keynote speeches, 5 invited speeches, 6 oral sessions and 1 poster session. Through this conference, we hope we could engage with all of the participants in a constructive discussion on Computer Graphics and Image Processing and related topics and exchange ideas.

We believe that CGIP 2023 will provide a timely arena where the experts and scholars from all over the world to present and discuss their recent and development results in all aspects of advanced technology. Also we hope that the conference provides good chances to promote international friendship among the experts and scholars in this field and continues to do so for years to come.

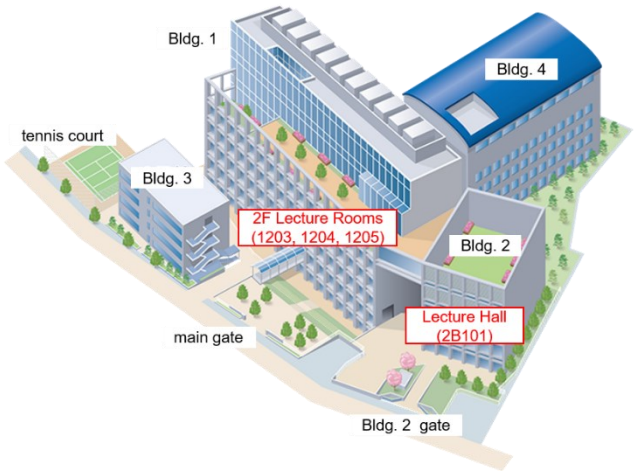
We truly believe the participants will find the discussion fruitful and will enjoy the opportunity for setting up future collaborations. We wish all of you have an unforgettable and prefect experience in the conference.

General Chair
Prof. Kohei Cho
Tokai University, Japan

Conference Venue

Takanawa Campus, Tokai University

Address: 2-3-23, Takanawa, Minato-ku, Tokyo 108-8619



Campus Map

Bldg.2 gate to Lecture Hall

Lecture Hall-2B-101

Takanawa campus is conveniently situated in the commercial heart of Tokyo, next to the bustling business district of Shinagawa. Home to many of the leading manufacturers in the digital communications sector, Shinagawa is the ideal location to pursue strategic partnerships with industry in the education space.

Traffic Guidelines

15 min. walk from JR or Keihin-kyuko Train Line Shinagawa station.

Or take the Toei bus from Shinagawa station bound for Meguro station and get off at Takanawa Keisatusho Mae stop.

It is a 10 min. walk from Toei Subway Asakusa Line (No. 1) Sengakuji station.

It is a 8 min. walk from Shirokane-Takanawa station on Tokyo-Metro Nanboku Line / Toei Subway Mita Line.

The access/map is available from: https://goo.gl/maps/xq3XuSAvzFbWXS518.

Presentation Guideline

Presentation Requirement

- At least one author should present for each abstract/full paper during the session.

Time Zone

- The time shown in this schedule is **Greenwich Mean Time (GMT+9) – Japan Standard Time**.

Warm Tips for Presentation

- English is the official language.
- Get your presentation PPT/Slides prepared.
- Keynote Speech: about 35 Minutes of Presentation and 5 minutes of Q&A.
- Invited Speech: about 20 Minutes of Presentation and 5 minutes of Q&A.
- Oral Presentation: about 12 Minutes of Presentation and 3 minutes of Q&A.
- One Best Oral Presentation will be selected from each session, and the result will be announced at the end of the session.

Onsite Presentation Instruction

- **Devices Provided by the Conference Organizer:**
  (a) Laptop Computer (MS Windows Operating System with MS PowerPoint and Adobe Acrobat Reader). (b) Digital Projectors and Screen. (c) Laser Stick. (d) Materials Provided by the Presenters: PowerPoint or PDF Files (Files should be copied to the Conference laptop at the beginning of each Session.)

- **Instruction for Poster Presentation:**
  Materials Provided by the Conference Organizer: The place to put posters. Materials Provided by the Presenters: (a) Home-Made Posters: Submit the poster to the staff when signing in. (b) Maximum poster size is A1. (c) Load Capacity: Holds up to 0.5 kg.

- **Conference Material:**
  All presented papers will be issued with hard copy of conference materials: Receipt/Invoice, Participation and presentation certificate, Conference program book, etc.

- **Dress Code:**
  Please wear formal clothes or national representative of clothing.

Personal Insurance

- Along with your registration, you will receive your name badge, which must be worn when attending all conference sessions and activities. Participants without a badge will not be allowed to enter the conference venue.

- For your safety, please do not lend your name badge to the persons who are not involved in the conference and bring the irrelevant persons into the conference venue.

- The conference organizers cannot accept liability for personal injuries, or for loss or damage of property belonging to conference participants, either during, or as a result of the conference. Please check the validity of your own insurance.

Presentation Guideline

Online Presentation Instruction

- **Equipment Needed:**
  (a) A computer with an internet connection (wired connection recommended). (b) USB plug-in headset with a microphone (recommended for optimal audio quality). (c) Webcam (optional): built-in or USB plug-in. (d) Please set up your laptop time in advance.

- **Download the ZOOM:**
  https://zoom.us/download;
  https://www.zoom.com.cn/download.

- **Learn the ZOOM skills:**
  https://support.zoom.us/hc/en-us/articles/201362033-Getting-Started-on-Windows-and-Mac

- **How to use ZOOM:**
  (a) Set the language. (b) Test computer or device audio. (c) Join a meeting: Join the meeting with "meeting ID" provided in the program, tap the name as "paper ID+name", eg.: "G0001-Kira Yue", then click "Join". (d) Get familiar with the basic functions: Rename, Chat, Raise Hands, Start Video, Share Computer Sound and Share Screen, etc.

- **Environment Requirement:**
  (a) Quiet Location. (b) Stable Internet Connection. (c) Proper Lighting.

- **Test Session:**
  On Jan. 13, there are test sessions. On that day, all the above functions will be taught including how to use ZOOM. If you don't know how to use, please do not worry. However, please do download ZOOM and log in the meeting room in advance, then, you can join the conference.

- **Voice Control Rules during the Presentation:**
  (a) The host will mute all participants while entering the meeting. (b) The host will unmute the speakers' microphone when it is turn for his or her presentation. (c) Q&A goes after each speaker, the participant can raise hand for questions, the host will unmute the questioner. (d) After Q&A, the host will mute all participants and welcome next speaker.

- To effectively control the time and avoid some unexpected situations, it is suggested that you should record your presentation ahead of time, play the video or do the live oral presentation online while it's your turn for presentation.

  Step 1: Author records a video introduction with their own image, speaking to the camera, introducing themselves: name, affiliation, brief description of scope of their work.
  Step 2: Author then switches to their slides and provides a voiceover describing images in each slide.
  Step 3: Author needs to be able to upload these presentations to a location specified by YOU in advance. Send the video to the staff in advance.

- **Conference Material:**
- All presented papers will be issued with soft copy of conference materials: Receipt/Invoice, Participation and presentation certificate, etc.

Presentation Guideline

- **Notes:**
  (a) Log in the meeting room 15 minutes ahead of the session. (b) Learn the zoom skills. (c) Your punctual arrival and active involvement in each session will be highly appreciated. (d) The conference will be recorded; we will appreciate your proper behavior.

Contact Us

- Contact us by email: cgip_info@163.com or We-chat for any inquires.

Program-at-a-Glance

Arrival Registration-Jan. 13, 2023 (Friday), GMT+9

Arrival Registration & Conference Material Collection	Duration
Venue: Entrance of 2B101 Lecture Hall (1F of Building 2)	10:00-16:00

Test Session, Jan. 13, 2023 (Friday), GMT+9

Keynote and Invited Speaker Test----ZOOM A: 83764998023 Link: https://us02web.zoom.us/j/83764998023	Duration
Keynote Speaker IV Prof. David Zhang, The Chinese University of Hong Kong (Shenzhen), China	10:30-10:40
Invited Speaker I Prof. Hongmin Gao, Hohai University, China	10:40-10:50
Invited Speaker II Prof. Xiaodan Fan, The Chinese University of Hong Kong, Hong Kong	10:50-11:00
Invited Speaker III Assoc. Prof. Yiyu Cai, Nanyang Technological University, Singapore	11:00-11:10
Invited Speaker IV Prof. Issei Fujishiro, Keio University, Japan	11:10-11:20
Invited Speaker V Prof. Xiaogang Jin, Zhejiang University, China	11:20-11:30
Break	11:30-14:30
Author Test----ZOOM A: 83764998023 **Link: https://us02web.zoom.us/j/83764998023**	**Duration**
Oral Session 5--Bioinformatics and Biomedical Sensors for Noninvasive Monitoring G2024-A, G2022-A, G3015-A, G2002, G2031-A, G3006, G2026-A, G2076-A, G3005, G2025-A	14:30-15:30
Oral Session 6-- Biomedical Signal and Image Processing G3004, G2055, G2038-A, G2047, G0001, G2070, G1003, G1004	15:30-16:10

Tips:

Please arrive at the Conference Room or log in the ZOOM Room 15 minutes ahead of the session. The duration for Keynote Speech: about 35 Minutes of Presentation and 5 minutes of Q&A. The duration for Invited Speech: about 20 Minutes of Presentation and 5 minutes of Q&A. The duration for Regular Presentation: about 12 Minutes of Presentation and 3 minutes of Q&A

Program-at-a-Glance

Onsite Session-Jan. 14, 2023 (Saturday), GMT+9

Takanawa Campus, Tokai University, Tokyo, Japan

Arrival Registration & Conference Material Collection	**Duration**
Venue: Entrance of 2B101 Lecture Hall (1F of Building 2)	09:30-17:00

Meeting Room: 2B101 Lecture Hall (IF of Building 2) **ZOOM A: 83764998023, Link: https://us02web.zoom.us/j/83764998023**	**Duration**
Opening Remarks--Prof. Kazuhiko Hamamoto, Tokai University, Japan	09:30-09:40
Keynote Speaker I--Prof. Michio Iwaoka, Tokai University, Japan Speech Title: "Selenium Analogs of Nucleosides and Proteins"	09:40-10:20
Keynote Speaker II--Prof. Stephen Kwok-Wing Tsui, The Chinese University of Hong Kong, Hong Kong Speech Title: "Application of Metagenomics Analysis on Human Diseases"	10:20-11:00
Group Photo & Break	11:00-11:25
Keynote Speaker III--Prof. Kohei Cho, Tokai University, Japan Speech Title: "Importance of Sea Ice Observation from Space for Monitoring the Global Warming"	11:25-12:05
Break	12:05-13:40

Room 1203 (2F of Building 1) **ZOOM A: 83764998023** **Link: https://us02web.zoom.us/j/83764998023**	**Room 1204 (2F of Building 1)** **ZOOM B: 88926005231** **Link: https://us02web.zoom.us/j/88926005231**	**Duration**
Oral Session 1--Bioinformatics and Biochemistry G2014, G2027, G2037-A, G2068-A, G2059-A, G2041-A, G2060-A, G2018-A, G2080-A	**Oral Session 2**--Medical Imaging, Biomedical Image Processing and Machine Learning in Biomedicine G2054, G2046-A, G3009-A, G0003-A, G0009-A, G0017, G1005	13:40-15:55
Break		15:55-16:15
Oral Session 3--Pharmacy and Biomedical Materials G2012-A, G2008-A, G2081, G2010-A, G2015-A, G2016-A, G2053-A, G3010-A, G3007-A	**Oral Session 4**--Computer Vision and Image Processing G0006, G1002-A, G0012, G0018, G0010, G0014, G0015-A, G0016, G0013	16:15-18:30

Room 1205 (2F of Building 1)	**Duration**
Poster Session--Bioinformatics, Biochemistry and Bioscience G2028-A, G2032-A, G2023, G2062-A, G2071-A, G2064-A, G2033-A, G2035-A, G2069-A, G2066-A, G2079-A, G2020-A, G2061-A, G2067-A, G0007-A, G2030-A, G0011-A	13:40-18:30

Program-at-a-Glance

Online Session-Jan. 15, 2023 (Sunday), GMT+9

ZOOM A: 83764998023 Link: https://us02web.zoom.us/j/83764998023	Duration
Keynote Speaker IV--Prof. David Zhang, The Chinese University of Hong Kong (Shenzhen), China Speech Title: "Advanced Biometrics: Research and Development"	09:30-10:10
Invited Speaker I--Prof. Hongmin Gao, Hohai University, China Speech Title: "Deep Learning Approaches for Hyperspectral Image Classification"	10:10-10:35
Invited Speaker II--Prof. Xiaodan Fan, The Chinese University of Hong Kong, Hong Kong Speech Title: "Elucidate Protein Structural Space from Molecular Dynamics Data"	10:35-11:00
Group Photo & Break	11:00-11:10
Invited Speaker III--Assoc. Prof. Yiyu Cai, Nanyang Technological University, Singapore Speech Title: "Automatic Reconstruction of Mechanical and Electric Plumbing"	11:10-11:35
Invited Speaker IV--Prof. Issei Fujishiro, Keio University, Japan Speech Title: "Psychologically Based Stereoscopic Viewing"	11:35-12:00
Invited Speaker V--Prof. Xiaogang Jin, Zhejiang University, China Speech Title: "TBA"	12:00-12:25
Break	12:25-13:30
ZOOM A: 83764998023 Link: https://us02web.zoom.us/j/83764998023	**Duration**
Oral Session 5--Bioinformatics and Biomedical Sensors for Noninvasive Monitoring G2024-A, G2022-A, G3015-A, G2002, G2031-A, G3006, G2026-A, G2076-A, G3005, G2025-A	13:30-16:00
Break	16:00-16:15
Oral Session 6--Biomedical Signal and Image Processing G3004, G2055, G2038-A, G2047, G0001, G2070, G1003, G1004	16:15-18:15

Tips:

Please log in the ZOOM Room 15 minutes ahead of the session. The duration for Invited Speech: about 20 Minutes of Presentation and 5 minutes of Q&A. The duration for Regular Presentation: about 12 Minutes of Presentation and 3 minutes of Q&A.

Opening Remarks

Duration: 09:30-09:40, Jan. 14, 2023 (Saturday), GMT+9

Meeting Room: 2B101 Lecture Hall (IF of Building 2)

ZOOM A: 83764998023, Link: https://us02web.zoom.us/j/83764998023

Prof. Kazuhiko Hamamoto
Tokai University, Japan

He received the doctor's degree, the master's degree and the bachelor's degree in engineering from Tokyo University of Agriculture and Technology in 1994, 1991 and 1989 respectively. Currently, he is a provost of College of Science and Technology and dean of Graduate School of Information and Telecommunication Eng., Tokai University, Japan. His research interests are medical information, human interface and virtual reality. He has about 60 papers (Transactions and Journals) and about 85 papers (International Conference). He is a member of IEEE and many national societies in Japan. He also takes some active parts in national societies as a committee member.

Keynote Speaker I

Duration: 09:40-10:20, Jan. 14, 2023 (Saturday), GMT+9
Meeting Room: 2B101 Lecture Hall (IF of Building 2)
ZOOM A: 83764998023, Link: https://us02web.zoom.us/j/83764998023

Prof. Michio Iwaoka
Tokai University, Japan

Professor Iwaoka received Doctor of Science in 1994 from the University of Tokyo with his research on the weak atomic interactions of organoselenium compounds and the applications to chemical biology fields. After working as a research associate in the University of Tokyo, he moved to the Department of Chemistry of Tokai University as an associate professor and promoted to a full professor in 2009. In 2022, he was also appointed as a director of Institute of Advanced Biosciences, Tokai University. During his career, he was a visiting scientist at Cornell University from 1995 to 1997, a visiting professor at Cardiff University in 2008, at Korean Institute of Advanced Technology (KIAS) in 2010, and at Perugia University in 2016. He is currently an International board member of the network of SeSRedCat, Co-editor of Current Chemical Biology, and Editorial board member of Molecules and Main Group Chemistry. His research interest covers chalcogen chemistry, chemical biology, protein folding, weak atomic interactions, and molecular assembly.

Speech Title: "Selenium Analogs of Nucleosides and Proteins"

Abstract: Chalcogen analogues, which are synthetic derivatives of natural nucleic acids or proteins with a substitution of sulfur (S), selenium (Se) or tellurium (Te) at any specific positions, show unique biological activities, which are significantly different from the original biomolecules, thus stimulating our interest and anticipating various applications. In this lecture, recent advances in the chemical synthesis of selenium analogs of nucleosides and proteins as well as the assessments of their unique biological properties are focused, exemplifying our recent achievements.

Keynote Speaker II

Duration: 10:20-11:00, Jan. 14, 2023 (Saturday), GMT+9

Meeting Room: 2B101 Lecture Hall (IF of Building 2)

ZOOM A: 83764998023, Link: https://us02web.zoom.us/j/83764998023

Prof. Stephen Kwok-Wing Tsui (h-index: 56)
The Chinese University of Hong Kong, Hong Kong

TSUI Kwok-Wing Stephen is currently a Professor and the Associate Director (Research) in the School of Biomedical Sciences. He is also the Director of Hong Kong Bioinformatics Centre in the Chinese University of Hong Kong (CUHK). In 1995, he received his PhD degree in Biochemistry at CUHK. He was then appointed as an Assistant Professor in the Biochemistry Department in 1997 and promoted to the professorship in 2004. He was also a former member of the International HapMap Consortium and worked on the single nucleotide polymorphisms of human chromosome 3p. During the SARS outbreak in 2003, his team was one of the earliest teams that cracked the complete genome of the SARS-coronavirus and facilitated the emergence of real-time PCR assay for the virus. Totally, he has published more than 240 scientific papers in international journals, including Nature, Nature Machine Intelligence, New England Journal of Medicine, Lancet, PNAS, Nucleic Acids Research, Genome Biology and Bioinformatics. His h-index is 56 and the citations of his publications are over 20,000. His major research interests are next generation sequencing, bioinformatics and metagenomics in human diseases.

Speech Title: "Application of Metagenomics Analysis on Human Diseases"

Abstract: Microbes have co-evolved with human beings for millions of years. They play a very important role in maintaining the health of the host. With the advancement in next generation sequencing technology, the microbiome profiling in the host can be easily obtained under different circumstances. In this talk, results of microbiome studies on many human diseases will be presented. Special focuses will be put on infectious diseases and allergic diseases. The implications of microbiome results on disease diagnosis and treatment will be also discussed.

Keynote Speaker III

Duration: 11:25-12:05, Jan. 14, 2022 (Saturday), GMT+9

Meeting Room: 2B101 Lecture Hall (IF of Building 2)

ZOOM A: 83764998023, Link: https://us02web.zoom.us/j/83764998023

Prof. Kohei Cho
Tokai University, Japan

Kohei Cho graduated from Department of Applied Physics at the Tokyo University of Science in 1979 and finished his master course on remote sensing at Chiba University in 1981. After working ten years at the Remote Sensing Technology Center of Japan (RESTEC), he joined Tokai University. He has served several times as the Technical Commissions officers of the International Society for Photogrammetry and Remote Sensing (ISPSR). He has been the General Secretary of the Asian Association on Remote Sensing (AARS) since 2009. He has published more than 100 papers on remote sensing in national & international journals and proceedings. He is also co-author of 15 books on remote sensing and image processing. His scientific interest includes but not limited to sea ice monitoring using passive microwave sensors, disaster monitoring from space, and e-Learning. He was awarded the Dr. Boon Indrambarya Gold Medal of AARS in 2009, the Samuel Gamble Award of ISPRS in 2012, and ISPRS Fellow in 2022.

Speech Title: "Importance of Sea Ice Observation from Space for Monitoring the Global Warming"

Abstract: Global warming is one of the most serious problems facing mankind in the 21st Century. The IPCC WG1 report published in August 2021 says that Global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in CO2 and other greenhouse gas emissions occur in the coming decades. Sea ice has an important role of reflecting the solar radiation back into space. However, once the sea ice melt, the open water starts to absorb the solar radiation which may speed-up the global warming. This is called ice albedo feedback. Thus, monitoring of sea ice is very important from global warming point of view. Sea ice observation from space using sensors onboard satellites is a powerful tool for monitoring the global distribution of sea ice on daily basis. In my talk, after shortly reviewing the current status of global warming, the technologies of monitoring sea ice from space will be presented including the reduction trend of sea ice distribution of the Arctic Sea.

Keynote Speaker IV

Duration: 09:30-10:10, Jan. 15, 2023 (Sunday), GMT+9

ZOOM A: 83764998023, Link: https://us02web.zoom.us/j/83764998023

Distinguished Presidential Chair Prof. David Zhang

FIEEE, FIAPR, FRSC and FCAE

The Chinese University of Hong Kong (Shenzhen), China

David Zhang graduated in Computer Science from Peking University. He received his MSc in 1982 and his PhD in 1985 in both Computer Science from the Harbin Institute of Technology (HIT), respectively. From 1986 to 1988 he was a Postdoctoral Fellow at Tsinghua University and then an Associate Professor at the Academia Sinica, Beijing. In 1994 he received his second PhD in Electrical and Computer Engineering from the University of Waterloo, Ontario, Canada. He has been a Chair Professor at the Hong Kong Polytechnic University where he is the Founding Director of Biometrics Research Centre (UGC/CRC) supported by the Hong Kong SAR Government since 1998. Currently he is Distinguished Presidential Chair Professor in Chinese University of Hong Kong (Shenzhen). Over past 40 years, he has been working on pattern recognition, image processing and biometrics, where many research results have been awarded and some created directions, including medical biometrics and palmprint recognition, are famous in the world. So far, he has published over 20 monographs, 500+ international journal papers and 40+ patents from USA/Japan/China. He has been continuously 8 years listed as a Global Highly Cited Researchers in Engineering by Clarivate Analytics during 2014-2021. He is also ranked about 47 with H-Index 126 at Top 1,000 Scientists for international Computer Science. Professor Zhang is selected as a Fellow of both RSC (Royal Society of Canada) and CAE (Canadian Academy of Engineering). He also is a Croucher Senior Research Fellow, and an IEEE Life Fellow and an IAPR/AAIA Fellow.

Speech Title: "Advanced Biometrics: Research and Development"

Abstract: In recent times, an increasing, worldwide effort has been devoted to the development of automatic personal identification systems that can be effective in a wide variety of security contexts. As one of the most powerful and reliable means of personal authentication, biometrics has been an area of particular interest. It has led to the extensive study of biometric technologies and the development of numerous algorithms, applications, and systems, which could be defined as Advanced Biometrics. This presentation will systematically explain this new research trend. As case studies, a new biometrics technology (palmprint recognition) and two new biometrics applications (medical biometrics and aesthetical biometrics) are introduced. Some useful achievements could be given to illustrate their effectiveness.

Invited Speaker I

Duration: 10:10-10:35, Jan. 15, 2023 (Sunday), GMT+9

ZOOM A: 83764998023, Link: https://us02web.zoom.us/j/83764998023

Prof. Hongmin Gao

Hohai University, China

Hongmin Gao received the B.S. degree in communication engineering from Hohai University, Nanjing, China, in 2006, and the Ph.D. degree in computer application technology from Hohai University, Nanjing, China, in 2014. He is currently a Professor and doctoral supervisor with the College of Computer and Information, Hohai University. He is the deputy director of Jiangsu marine monitoring equipment and data processing engineering center. He also has been approved for the "333 Project" of Jiangsu Province as young and middle-aged academic leaders in 2022. In the last five years, he was undertaking two research projects supported by the National Natural Science Foundation of China (NSFC), one research project supported by Jiangsu Natural Science Foundation, one research project supported by transformation of scientific and technological achievements in Jiangsu Province and participating the National Key R&D Program of China. Part of the research results have been applied in water resource flood disaster monitoring and operation decision supporting System of water conservancy, which won the second prize of Jiangxi Province Science and Technology Advancement Reward in 2018. His research interests include deep learning, information fusion, and image processing in remote sensing.

Speech Title: "Deep Learning Approaches for Hyperspectral Image Classification"

Abstract: Advances in computing technology have fostered the development of new and powerful deep learning (DL) techniques, which have demonstrated promising results in a wide range of applications. Particularly, DL methods have been successfully used to classify remotely sensed data collected by Earth Observation (EO) instruments. Hyperspectral imaging (HSI) is a hot topic in remote sensing data analysis due to the vast amount of information comprised by this kind of images, which allows for a better characterization and exploitation of the Earth surface by combining rich spectral and spatial information. This report focuses on the topic of hyperspectral image classification based on deep learning approaches. This is the important part of our previous work, mainly including mixed depth-wise convolution, dual-branch attention and hybrid convolutional and transformer network. Experimentally, compared with traditional methods, aforementioned deep learning models can obtain more useful information from remote sensing images, thus improving classification accuracy.

Invited Speaker II

Duration: 10:35-11:00, Jan. 15, 2023 (Sunday), GMT+9

ZOOM A: 83764998023, Link: https://us02web.zoom.us/j/83764998023

Prof. Xiaodan Fan

The Chinese University of Hong Kong, Hong Kong

Dr. Xiaodan Fan is a Professor of Department of Statistics, The Chinese University of Hong Kong, Hong Kong SAR, China. He received his Ph.D. degree in Statistics from Harvard University. Before that, he got his B.E. degree in Automation and M.S. degree in Pattern Recognition & Intelligent Systems from Tsinghua University. Dr. Fan is interested in solving Bioinformatics problems through probabilistic modeling and statistical computing. His recent research topics include genomic sequence analysis, genetic association study, microarray data analysis, statistical protein structure and function studies, DNA methylation analysis, gene network reconstruction, Bayesian methods, MCMC algorithms, model-based classification and clustering.

Speech Title: "Elucidate Protein Structural Space from Molecular Dynamics Data"

Abstract: Molecular Dynamics simulation produced a large amount of data for probing protein structures. We introduced two kinds of statistical methods to analyze such dataset in order to elucidate the energy landscape of the structural space of the corresponding protein. One method is based on a probabilistic Markov model for the transition among metastable states of the structural space. The other method tries to combine geometric information with dynamic information through a partition tree. We show that our methods outperform other methods on benchmark systems.

Invited Speaker III

Duration: 11:10-11:35, Jan. 15, 2023 (Sunday), GMT+9

ZOOM A: 83764998023, Link: https://us02web.zoom.us/j/83764998023

Assoc. Prof. Yiyu Cai
Nanyang Technological University, Singapore

Assoc. Prof. Yiyu Cai did his PhD training in Engineering, MSc training in Computer Graphics & Computer-aided Geometry Design, and BSc training in Math. He is currently a tenured faculty with the School of Mechanical & Aerospace Engineering in NTU and holds a joint appointment with NTU's Institute for Media Innovation. Prior to that, he was a R&D specialist with the Kent Ridge Digital Labs, a senior software engineer with the Center for Information-enahnced Medicine (CIeMed) - a joint venture between John Hopkins Medical School and the Institute of System Sciences, and a lecturer with Zhejiang University. He has been doing interdisciplinary research related to Interactive Digital Media (IDM). His research interest includes 3D based design, simulation, serious games, virtual reality, etc. He is also active in IDM application research for Engineering, Bio & Medical Sciences, Education, Arts, etc. Together with his students or collaborators, he has edited 3 books and 4 journal special issues, and published over 160 papers in peer-reviewed international journals or international conferences.

Speech Title: "Automatic Reconstruction of Mechanical and Electric Plumbing"

Abstract: Mechanical, electrical, and plumbing (MEP) system plays a crucial role in modern buildings. Often MEP system once constructed requires regular maintenance to avoid failure which can cause significant impacts operationally, economically, and even environmentally. Currently, modelling of existing MEP system is mostly a manual and tedious process. This talk will present a novel solution that reconstructs MEP systems from LiDAR scanned point cloud data. Our solution requires no additional data other than the unstructured point cloud with XYZ fields, no data preprocessing, and no prior knowledge of the pipe directions or dimensions. A novel deep learning network, PipeNet, is designed to detect pipes regardless of the size of the input data and the scale of the target scene, and predict the pipe centerline points together with other pipe parameters. The pipe model is then reconstructed through line fitting, refinement, and graph-based connectivity analysis constrained by domain knowledge to maximize the coherence of the piping system model. The final output is converted to the Industry Foundation Classes (IFC) format which is neutrally acceptable in the Building Information Modelling (BIM) industry. The solution is validated on both synthetic and actual scan data, and the results demonstrate its robustness, fast speed, and high recognition rate and precision.

Invited Speaker IV

Duration: 11:35-12:00, Jan. 15, 2023 (Sunday), GMT+9

ZOOM A: 83764998023, Link: https://us02web.zoom.us/j/83764998023

Prof. Issei Fujishiro
Keio University, Japan

Issei Fujishiro is currently a professor of information and computer science at Keio University. Before joining Keio in 2009, he had held a faculty position at the University of Tokyo, University of Tsukuba, Ochanomizu University, and Tohoku University. He received his Doctor of Science from the University of Tokyo in 1988. He has 37-year career in the field of visual computing, with a particular focus on modeling paradigms and shape representations, applied visualization design and lifecycle management, and smart multi-modal ambient media. He has served as an associate editor for several international journals, including IEEE Transactions on Visualization and Computer Graphics and Elsevier Computers and Graphics and Journal of Visual Informatics. He chaired 37 international conferences, including CG International 2017, IEEE VIS 2018/2019 (SciVis), and Cyberworlds 2019. He was the President of Institute of Image Electronics Engineers of Japan (IIEEJ) and Visualization Society of Japan, and a Vice President of the Society for Art and Science. He is presently appointed as a member of Science Council of Japan. He is a fellow of the Japan Federation of Engineering Societies and Information Processing Society of Japan and an honorary member of IIEEJ. He is a 2021 inductee into IEEE Visualization Academy.

Speech Title: "Psychologically Based Stereoscopic Viewing"

Abstract: Inspired by the trick artworks of young Japanese artist Hideyuki Nagai, we developed a simple, naked-eye stereoscopic viewing system for personal use. The system is equipped only with the orthogonal arrangement of two general-purpose display monitors together with a web camera and induces motion parallax by tracking the viewer's eyes to update the state of anamorphosis, known as monocular illusion expression. The stereoscopic effect perceived by the viewer may be degraded due to binocular disparity, especially when the system is being used with small display monitors. It has been empirically proven that the sense of presence can be improved by placing a so-called Cyclopean eye at a specific position on the line between the two eyes to obtain pinpointed anamorphosis. The system, however, experiences a problem wherein displayed objects may be either partially beyond the rendering area or completely missing, depending on the object's position relative to the user's viewpoint, resulting in a reduced stereoscopic effect. We attempt to address this problem by employing a so-called frame break method that has recently been used in filmmaking and advertisement. I report on a trial porting of the system to a commercially available laptop PC with a foldable display.

Invited Speaker V

Duration: 12:00-12:25, Jan. 15, 2023 (Sunday), GMT+9

ZOOM A: 83764998023, Link: https://us02web.zoom.us/j/83764998023

Prof. Xiaogang Jin
Zhejiang University, China

Xiaogang Jin is a professor in the State Key Laboratory of CAD&CG, Zhejiang University. He is the Director of Zhejiang University-Tencent Game Intelligent Graphics Innovation Technology Joint Laboratory, Chairman of Zhejiang Virtual Reality Industry Alliance. He has published more than 150 papers in important international academic journals such as ACM Transactions on Graphics (Proc. of Siggraph, Proc. of Siggraph Asia), IEEE Transactions on Visualization and Computer Graphics, IEEE Transactions on Image Processing, IEEE Transactions on Multimedia, Computer-Aided Design, etc. His current research interests include digital human, cloth animation, traffic simulation, collective behavior simulation, virtual try-on, digital face, implicit surface modeling and applications, creative modeling, computer-generated marbling, sketch-based modeling, and virtual reality. He received an ACM Recognition of Service Award in 2015 and the Best Paper Awards from CASA 2017 and CASA 2018.

Speech Title: TBA

Session 1

Session 1: Bioinformatics and Biochemistry

Time: 13:40-15:55, Jan. 14, 2023 (Saturday), GMT+9
Venue: Room 1203 (2F of Building 1)
ZOOM A: 83764998023, Link: https://us02web.zoom.us/j/83764998023
Session Chair: Prof. Wen-chang Lin, Academia Sinica, Taiwan

S1-1	G2014 13:40-13:55	Predicting Single Cell Genotypes from Single Cell Expression Profiles in AML Using Deep Learning **Georgios Asimomitis**, Maria Sirenko, Christos Fotis, Dan A Landau, Leonidas G Alexopoulos, and Elli Papaemmanuil Memorial Sloan Kettering Cancer Center, USA Abstract—Acute myeloid leukemia (AML) is an aggressive hematologic malignancy composed of a mixture of genotypically, phenotypically and functionally diverse cell populations including wild-type (WT) cells. The generation of high throughput single cell gene expression and mutational profiles in AML enables the deployment of deep learning frameworks for gaining insights on how genotypic changes are associated with disease phenotypes. However, the question if the single cell gene expression patterns together with the computational power of neural networks have the capacity to predict a cell's genotype remains unclear. In this study, we train two supervised deep learning models to predict the cell's malignant or wild-type (WT) status as well as the mutational status of specific genomic abnormalities in a binary and multi-class multi-label setting respectively, based on single cell RNA sequencing data from 6 AML patients and 4 healthy individuals. In the independent test sets, the binary classification model achieved an accuracy of 98% while the multi-class multi-label model achieved a macro-average AUC ROC of 0.84. Moreover, applying black box feature selection on the trained networks identified genes involved in biological processes and pathways of reported significance in AML, such as the IL-2/STAT5 and NF-kB signaling pathways. Overall, this study proposes two deep learning tasks for the prediction of single cell genotypic profiles from single cell expression data and showcases how the trained models can be used for the derivation of biologically related signals.
S1-2	G2027 13:55-14:10	Genomic Insights into Antimicrobial-Producing Pseudomonas Aeruginosa SWUC02 **Kotchanat Srisangchun**, Komwit Surachart, Kwannan Nantavisai, Onanong Pringsulaka, and Siriruk Sarawaneeyaruk Srinakharinwirot University, Thailand Abstract—Pseudomonas aeruginosa is an abundant bacterium in nature. Several P. aeruginosa strains are capable of producing a wide range of secondary metabolites with broad-spectrum high antimicrobial activity. This study aims to identify antimicrobial activity genes of P. aeruginosa SWUC02 by whole-genome sequencing analysis. Whole genome sequencing of P. aeruginosa SWUC02 was proceeded with the BGISEQ-500 sequencing system. The genome of P. aeruginosa SWUC02 is a single circular chromosome with 6,404,055 bp. 6,214 coding sequences were identified by RAST. We compared P.

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		aeruginosa SWUC02 against two reference strains: P. aeruginosa LV and P. aeruginosa PAO1, according to their antimicrobial activity. Our result shows that several antimicrobial gene clusters including bacteriocins, secondary metabolites, and siderophores are shared among P. aeruginosa SWUC02 and the two reference strains. The notable difference arises in secondary metabolite gene clusters where we identified pyocyanine and thanamycin in P. aeruginosa SWUC02 genome, which are absent from the reference strains. P. aeruginosa SWUC02 shows the potential for being a prospective antagonist and warrants a follow up study for antimicrobial compound production.
S1-3	G2037-A 14:10-14:25	Top Ranked Transcripts of Human Protein-coding Genes Interrogated with GTEx V8 and V9 Datasets **Wen-chang Lin** Academia Sinica, Taiwan Abstract—While massive RNA-Seq NGS data provides more understanding on the gene expression, there are issues to accurately determine levels of alternative mRNA isoforms with short-read NGS datasets. Recently, the Genotype-Tissue Expression (GTEx) project released both the illumina short-read based transcriptome dataset (V8) and oxford nanopore single molecule sequencing based dataset (V9) for various human tissue samples. It is recognized that only dominant protein-coding transcripts are responsible for protein peptide productions and biological pathways. We were interested to interrogate and compare the expression profiles on top ranked protein-coding transcripts (TRP-Tx) among the GTEx short-read and long-read transcriptome datasets. We utilized the GENCODE biotype feature to identify a TRP-Tx transcript for each protein-coding gene by choosing the most expressed protein-coding transcripts of protein-coding genes. There are 19,589 TRP-Tx transcripts in the V8 dataset and 18,516 TRP-Tx transcripts identified in V9, with around 90% of TRP-Tx were the most expressed Rank1 transcripts. We then observed that more than 70% of protein-coding genes (13,542) have common TRP-Tx transcripts in the V8 and V9 datasets. Furthermore, while the TRP-Tx selection variations were partly affected by tissue coverage differences, it is suggested that long-read V9 transcriptome dataset could provide better assessment on the transcript isoform distributions.
S1-4	G2068-A 14:25-14:40	Transcriptome Analysis Reveals the Molecular Mechanisms Related to Drought Tolerance in Tea Plants, Camellia Sinensis **Nguyen Hoang Khoi Le**, Chih-Yi Hu, Chiou-Fang Liu, Anggun Sausan Firdaus, Ateesha Negi, and Shu-Dan Yeh National Central University, Taiwan Abstract—Breeding for adaptation to drought stress in tea plant, Camellia sinensis, is one sustainable mean to cope with global threats of more frequent and severe drought. However, it remains challenging due to limited understanding of the molecular basis of drought tolerance in tea. This study investigates transcriptome dynamics of four genetically-related tea cultivars contrasting in drought response (tolerant and sensitive) under water-deficit treatment. Approximately 860 million high-quality paired-end reads

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		generated from 24 cDNA libraries were mapped to the recently assembled Tieguanyin tea genome with the average mapping rate of 92.03%. Genes involved in phenylpropanoid biosynthesis, lignin biosynthesis, and flavonoid biosynthesis pathways; ABC and MATE transporters are highly up-regulated in tolerant cultivars, suggesting the accumulation of secondary metabolites as one of the antioxidative defenses under water-deficit condition in tea. In addition, several transcription factors probably involving ABA-dependent and independent pathways are differentially expressed commonly in tolerant but not sensitive cultivars. A set of 93056 exonic SNPs putatively associated with drought tolerance is inferred from the inheritance pattern of four cultivars. These results provide insight into drought-defensive responses at molecular level and genomic resources for genetic manipulation and marker-assisted selection in crop improvement.
S1-5	G2059-A 14:40-14:55	Study on Interactions between an Amyloidogenic Protein Human Cystatin C and the Interface of Micellar and Liposomal Cell Membrane Mimetics **Przemyslaw Jurczak**, Marta Orlikowska, Igor Zhukov, Emilia Sikorska, Sylwia Rodziewicz-Motowidlo, and Paulina Czaplewska University of Gdansk, Poland Abstract—Human cystatin C (hCC), is a well-known cysteine protease inhibitor. While being a monomer in physiological conditions, under the necessary stimulus it tends to form fibrils, participating in the disease development. This process can potentially be regulated by cell membrane, which is being hypothesized to play a key role in the hCC oligomerization pathway. Following the theory and considering difficulties posed by the studies involving cell membranes, here we present an alternative in the form of monitoring the interactions between hCC and lipid membrane mimetics. As the oligomerization is one of the most crucial processes hCC undergoes, this study focuses on monitoring the process, determining which parts of the hCC sequence interact with membranes and verifying if those interactions may cause the protein oligomerization. In our study we have monitored the changes of the secondary structure and oligomeric state of the hCC protein in the presence of selected lipids with circular dichroism and size exclusion chromatography. We have also used SPR to determine binding constants for protein-lipid interaction. Finally, we have performed molecular dynamic simulations and 2D NMR experiments to determine which parts of the hCC interact with selected lipids and surfactants. Work supported by grant 2018/30/M/ST4/00039 from NCN, Poland.
S1-6	G2041-A 14:55-15:10	Characterization of Protein Glycosylation in Oleaginous Yeasts and Elucidation of Extracellular Targeting of Secreted Glycoproteins **Takamasa Fukunaga**, Yutaka Tanaka, Takao Ohashi, Tomoki Yoshimatsu, Yuki Morishima, Ryoichi Fukuda, Hiroaki Takaku, and Kaoru Takegawa Kyushu University, Japan Abstract—Glycosylation is a post-translational modification that is present in all kingdoms of life. Therapeutic proteins, both innovative and biosimilars, are mostly glycosylated. Glycans directly influence the stability, the pharmacokinetics and immunogenicity of the protein, and the products with non-humanized glycans limited their usage. Therefore,

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		various methods to develop humanized glycosylated end-products have been widely reported in yeasts because protein manufacturing costs are cheaper than in mammalian cells, and yeast systems are virus-free. Oleaginous yeast is a natural secretor of proteins and offers advantages over Saccharomyces cerevisiae as a eukaryotic host for the secretion of heterologous proteins. However, their glycosylation pathway and related mechanisms for producing humanized glycosylated proteins have rarely been reported. In this study, we have characterized the cell-surface glycans in Yarrowia lipolytica and Lipomyces starkeyi. we have examined the glycosylation of representative endogenous glycoprotein, secretory acid phosphatase (AP). AP is highly glycosylated and is a useful marker protein whose electrophoretic mobility on native gel depends on the size and number of N-linked oligosaccharides. AP of oleaginous yeasts migrated faster than that of S. cerevisiae. Moreover, the mobility of endoglycosidase-treated AP was slightly faster than that of non-treated sample. Therefore, N-linked oligosaccharides of oleaginous yeasts composed of low-molecular mass, which is suitable to humanized. And then, the oligosaccharides were extracted from these cell lysates and analyzed using HPLC and 1H NMR spectroscopy. N-linked oligosaccharides consist of slightly elongated galactomannan (Hex8-14). Furthermore, the elongated galactomannan was detected with covalently bound to β-(1,3)-glucans in the cell wall. These results suggested that almost all of elongated galactomannan were anchored to the cell wall, and secreted proteins do not contain elongated glycan. Therefore, our findings may help further innovation to enable safe glycoprotein pharmaceutical production. Moreover, we found that new machinery of targeting extracellular oligosaccharides to their final destinations in oleaginous yeasts, which is attributed to processing the galactomannans on yeast cell wall.
S1-7	G2060-A 15:10-15:25	Interaction Studies of Signalling Receptor HVEM with Peptide Inhibitors of HVEM/BTLA Interaction **Marta Orlikowska**, Marta Piotrowska, Katarzyna Kuncewicz, Marta Spodzieja, Pawel Niedzialkowski, and Sylwia Rodziewicz-Motowidlo University of Gdansk, Poland Abstract—Many strategies have been developed for the treatment of infectious diseases or cancer. One of the promising approaches to activate the therapeutic antitumor immunity is the blocking of immune checkpoints. Herpesvirus entry mediator (HVEM) serves as a bimolecular switch in the regulation of the host's immune response. Depending on the ligand to which it binds, HVEM can activate (LIGHT, LTα) or inhibit (BTLA, CD160) the functions of the immune system. Blocking the interaction of HVEM with BLTA/CD160 using small molecules (peptides or peptidomimetics) can be the way to stimulate the body's immune response. In our studies, we attempted to develop the efficient method for the expression and purification of the extracellular domain of HVEM using Escherichia coli. The activity of obtained multimers (dimers, trimers, and higher oligomers) was verified by enzyme-linked immunosorbent assay with BTLA and CD160. The obtained HVEM protein was tested for their ability to form a complex with peptide inhibitors using affinity chromatography, enzyme-linked immunosorbent assay and electrochemical impedance spectroscopy. Initial crystallization trials were performed for

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		active HVEM using vapor diffusion hanging drop method. This work was supported by a grant from the Polish National Science Center No. 2016/21/D/NZ1/02777
S1-8	G2018-A 15:25-15:40	Effect Of PAH and PM-Bound PAH on the Oligomerization of Amyloid Beta Peptide: Insights from Molecular Dynamics Simulations **Samal Kaumbekova**, Mehdi Amouei Torkmahalleh, Yanwei Wang, and Dhawal Shah Nazarbayev University, Kazakhstan Abstract—Amyloid beta (Aβ42) is a peptide with 42 aminoacids in its structure, generated from amyloid precursor protein. Aggregation of Aβ42 peptides into toxic low-molecular-weight oligomers in human brain is associated with the progression of Alzheimer's disease. Long-time exposure to particulate matter (PM) contributes to the increased risk of neurodegeneration. One of the typical constituents of ambient PM is polycyclic aromatic hydrocarbons (PAHs) and particle-bound PAHs. Although experimental studies showed the impact of PAHs on neurodegeneration, the molecular interactions remain obscure. In this study, we performed molecular dynamics simulations to investigate the impact of PAHs and particle-bound PAHs on the tetramerization of Aβ42 monomers. Benzo[a]pyrene (B[a]P) molecules were used as typical PAH, while "C60-(B[a]P)4" molecule was used to represent particle-bound PAH. The results showed that B[a]P molecules accelerated tetramerization by 30% and increased interpeptide electrostatic interactions. In comparison, C60-(B[a]P)4 accelerated the early aggregation of monomers by 8%. Although C60-(B[a]P)4 with a high surface area had higher interactions with oligomer, unbound B[a]P, due to its smaller size, had a more severe impact on the structure of Aβ42, which would lead to the progression of Alzheimer's. The in-vivo effect will be more complicated due to the complex composition of PM, demanding further experiments.
S1-9	G2080-A 15:40-15:55	A Deep Learning-Based Approach for Identifying DNA N4-Methylcytosine Sites **Chunting Liu**, Jiangning Song, Hiroyuki Ogata, and Tatsuya Akutsu Kyoto University, Japan Abstract—Among various modifications of DNAs, DNA N4-methylcytosine (4mC) is an important type of epigenetic modification and is involved in diverse biological processes. However, it is expensive and time-consuming to detect 4mC sites with experimental methods. Thus, several computational tools have been developed. How to effectively and fully exploit the complex relationships within DNA sequences remains the main challenge to improving the predictive capability. Herein, we propose a deep learning-based approach with multi-scale receptive fields to percept the long- and short-range relationships implied in the DNA sequences. Moreover, we take into consideration the unbalanced samples between different species and apply the calculated class weights in the loss to balance the training process. Extensive experiments show that our method achieves significant performance and outperforms other state-of-the-art methods. Further, the method provides an optimization perspective to better address the biological sequence classification problems.

Session 2

Session 2: Medical Imaging, Biomedical Image Processing and Machine Learning in Biomedicine
Time: 13:40-15:25, Jan. 14, 2023 (Saturday), GMT+9
Venue: Room 1204 (2F of Building 1)
ZOOM B: 88926005231, Link: https://us02web.zoom.us/j/88926005231
Session Chair: Prof. Hiroshi Fujita, Gifu University, Japan

S2-1	G2054 13:40-13:55	Averaging Model Weights Boosts Automated Lung Nodule Detection on Computed Tomography Andrei Tenescu, **Bogdan Alexandru Bercean**, Cristian Avramescu, and Marius Marcu Politehnica University of Timisoara, Romania Abstract—Lung nodule detection remains one of the most common and painstaking tasks in radiology. Efforts to aid overworked radiologists are made using artificial intelligence (AI), although computed tomography (CT) makes it a hard computational task in practical scenarios. This study analyses the translation of a weight-averaging ensemble technique, from natural image classification to small object detection on CT. A dataset of 1050 patients is used to fine-tune models under diverse configurations to compare different types of ensembles. The model soup boosts the FROC score from 0.872 to 0.886, with no computational downsides. Next, two radiologists test their detection performance with and without the ensemble assistance on 20 CT studies. The AI improves the physicians' mean sensitivity from 91.2 ± 5.1% to 94.2 ± 4.6%, while preserving a non-inferior specificity ($P < 0.001$). These results further pave the way to translating general computer vision advancements into the medical domain, supporting AI's place in the physician's toolbox.
S2-2	G2046-A 13:55-14:10	Development of an Interpretable Artificial Intelligence Model for the Decisions of Automatic Sleep Scoring **Chih-En Kuo** and Hao-Hsiang Wang National Chung Hsing University, Taiwan Abstract—For the diagnosis of sleep issues, all night polysomnographic recordings are usually taken from the patients and the recordings are scored by a expert. Manual sleep scoring is a subjective and time-consuming job. Until today, there are many automatic sleep scoring methods have been proposed to help the expert. However, many methods with high accuracy are constructed based on black-box models of deep learning technology. Experts cannot understand the reasons of model decisions and fully trust the model. Therefore, we proposed an interpretable model so that experts can understand the rationale behind model decisions. Our model is built using the concept of image captioning, which uses a convolutional neural network as the encoder to extract the feature maps of the sleep-signal spectrograms and a transformer model as the decoder to generate explanatory textual descriptions of the basis for model decisions. Total of 67 patients with sleep disorders were used to develop and validate our model. We use bilingual evaluation understudy (BLEU) to evaluate the performance of the model. The average BLEU score of our proposed model is as high as 0.8248. In the future, we will try to apply the model to other medical images to evaluate the effect.

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S2-3	G3009-A 14:10-14:25	Deep-Learning-Based Identification of Depression in Older Adults Using Activity Tracking Data **Myung-Geun Choi**, Tae-Rim Lee, and Mun-Taek Choi Sungkyunkwan University, South Korea Abstract—Geriatric depression is accompanied by an increased risk of dementia in the aging modern society. To overcome the limitations of the current complex, subjective, and costly diagnosis method for geriatric depression, it is necessary to develop a systematic and convenient way of using long-term time-series data from a consumer-level device such as a wrist-worn activity tracker. In this study, a depression classification model based on deep learning is trained by using the activity tracking data as direct input instead of preprocessed features from the time series data in the previous studies. In terms of performance, the analysis results of the deep learning model showed similar or improved results compared to the case of using the pre-processed features. This can be said to show the applicability of the time-series data processing ability of more generalized deep learning beyond the limits of pre-processed features in the classification of depression.
S2-4	G0003-A 14:25-14:40	Ultrasonic Image Enhancement by Circulated Scan and TOFD Techniques **Young-Fo Chang** and Jia-Wei Liu National Chung Cheng University, Taiwan Abstract—When ultrasounds are blocked by some obstacles or some areas cannot be illuminated by the ultrasounds due to the complex shape of targets, the targets may not be detected by ultrasonic testing (UT). Thus, the circulated scan combined with the time of flight diffraction (TOFD) techniques are proposed to conquer above-mentioned difficulties and its performance will be evaluated and compared with the commonly used B-scan synthetic aperture focusing technique (SAFT). In the circulated scan, the transducer circulates and always faces the center of the specimen. After scanning, the acquired scan data is processed by the TOFD. Study results show that the image of the circulated scan combined with TOFD is significantly superior to the image of B-scan SAFT. B-scan SAFT is recommended to detect the existence of shallow targets if the resolution of the image is secondary since this technique is simple and direct. However, the image of the circulated scan combined with TOFD is fine which shows this technique has better focusing capability to reveal the complex shape of the target. Thus, to reveal the shape of the target and the targets distributed in different depths, the circulated scan combined with TOFD is suggested.
S2-5	G0009-A 14:40-14:55	Neural Approaches for 3D Pose Estimation from 3D Data **Gali Hod** Playtika, Israel Abstract—This work addresses the problem of 3D human pose estimation from a point cloud. Human pose is an important component of numerous applications in AR, VR, automatic driving, gaming, and others. Most of the existing research is dedicated to extracting poses from 2D and depth images. This is so since the 2D media is the most

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		widespread source of data. However, recent advances in mobile technology turn any phone into a high quality 3D scanner. The amount of 3D data is constantly increasing. The need for tools to process the data is increasing too. There exist many "classical" pre-deep learning methods for human pose estimation from 3D data. While these methods provide accurate results, they have a significant drawback. They are not derivable and thus, difficult to incorporate in subsequent deep learning pipelines. We deal with the drawback by suggesting and implementing two neural network based approaches for 3D pose estimation. The first method utilizes part segmentation to classify the body part of each point, then estimates the body joints based on neighboring parts. The second method estimates joints from point clouds using an adjusted version of pointNet++, followed by a skeleton reconstruction. We evaluate both methods by calculating the MSE between the estimated and ground-truth pose per joint. The average MSE value, relative to the point cloud size which was normalized to unit sphere, was 0.025%and 0.05% correspondingly. The code will be available on Github.
S2-6	G0017 14:55-15:10	Optimal Design of Color Laparoscopic Super-Resolution Image Quality Based on Generative Adversarial Networks **Norifumi Kawabata** and Toshiya Nakaguchi Computational Imaging Lab, Japan Abstract—The Generative Adversarial Networks (GAN) is unsupervised learning enabled to transform according to data characteristics, though this generate unreal data by learning characteristics from data. As past our study, we discussed from the viewpoint of image quality for super-resolution of color laparoscopic image including SRCNN (Super-Resolution Convolutional Neural Network). However, it was not enough to compare to other neural network methods in our discussion. We consider that it is possible to support the medical image diagnosis by measuring whether the difference of both neural network method and image contents is affected or not for image quality. In this paper, first we carried out the objective image quality assessment by designing optimally of color laparoscopic super-resolution image using Generative Adversarial Networks (GAN). And then, we discussed for performance between methods comparing to result of SRCNN. On the other hand, from a view of information science, we consider that we need to verify experimentally for affect between network learning effect and generated image, and then to improve method. Therefore, we also discussed relationship between image quality and learning effect in color laparoscopic image generation using SRGAN.
S2-7	G1005 15:10-15:25	Arm Injury Classification on a Small Custom Dataset using CNNs and Augmentation **Yoshihiro Mitani** National Institute of Technology, Japan Abstract— Some situations do not have a wide public access to medical expertise, poor health care systems, or a shortage of physicians. Therefore, the development of computer-aided diagnosis (CAD) systems that automatically estimate the extents of patients' injuries is required to reduce the burden of diagnosis on physicians and to provide early diagnosis and early treatment of patients. This study presented

		convolutional neural networks (CNNs) and image data augmentation for classifying external arm injuries. The arm injury classification is a three-class problem: healthy, wound, and bruises. With the limited number of data available, image data augmentation of a perspective transformation was used to improve an overtraining problem of CNNs. The experimental results showed that the CNN with augmentation had a higher average accuracy.

Session 3

Session 3: Pharmacy and Biomedical Materials

Time: 16:15-18:30, Jan. 14, 2023 (Saturday), GMT+9
Venue: Room 1203 (2F of Building 1)
ZOOM A: 83764998023, Link: https://us02web.zoom.us/j/83764998023
Session Chair: Prof. San-Yuan Chen, National Yang Ming Chiao Tung University, Taiwan

S3-1	G2012-A 16:15-16:30	Double-Layered Microneedle-Based Transdermal Stage-Delivery of Dual Drug for Synergistic Keloid Treatment **Yong-Ji Chen**, Jen-Tsai Liu, Ching-Jung Chen, Wan-Yu Yen, San-Yuan Chen, and **Shwu-Jen Chang** I-Shou university, Taiwan Abstract—Keloid is an abnormal scar disease being characterized by excessive proliferation of fibroblast and over deposition of collagen during wound healing. So far, the therapeutic of keloid scar included corticosteroid injection, laser therapy, cryotherapy, radiotherapy. However, there still existed some irritating symptoms such as erythema, pain, and pruritus are often accompanied during treatment period, and even the keloid is easily relapsed after the treatment. Therefore, gelatin hydrogel was used prepared the dual-drug heterogeneous composite gelatin-structured microneedles which loading gallic acid (GA) and quercetin loaded amphiphilic gelatin nanoparticle (QAGN). As the dual drug released at different time, GA could be initially released for retarding of fibroblasts over growing, and quercetin was released as strong antioxidant to erase ROS generation for scar sustained invasion and has been the TGF-beta pathway inhibitor for regulating extracellular matrix production (collagen type I, III). As the cell viability, and ROS generation results shown that the GA indeed could inhibit fibroblasts proliferation. Furthermore, the data of qRT-PCR also indicated that the gene expressions of fibroblast (such as Col I, III) were downregulated in the dual drug synergy system. As above results have demonstrated using synergy of dual drug pharmacology is positive for preventive keloid scar forming.
S3-2	G2008-A 16:30-16:45	Characterization of Phospholipase A2 and 5'-Nucleotidase Purified from Tetraponera rufonigra Ant Venom **Suwatjanee Naephrai**, Supakit Khacha-ananda, Lalida Shank, and Panchika Prangkio Chiang Mai University, Thailand Abstract—The venom consists of various protein toxins, such as phospholipase A2 (PLA2) and 5'-nucleotidase (5NUC) which contributes to cytotoxic effect. However, the biochemical characterization of these enzymes and investigation of their therapeutic potentials in ant species are still limited as compared to other venomous species. This study aims to isolate two enzymes PLA2 and 5NUC from Tetraponera rufonigra, a lethal ant species. Crude venom was extracted from adult live ants by dual-phase separation using hexane: water (1:5 v/v) and separated by size exclusion chromatography using Toyopearl HW-55 column and 0.2 M ammonium bicarbonate, pH 8.0 as an eluting buffer. All protein fractions were characterized by BCA protein assay and SDS-PAGE. The molecular weight of

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		5NUC and PLA2 were identified as ~70 kDa and 30 kDa, respectively. The highest 5NUC activity was found in fraction number 30 with 291.42 ± 3.12 nmol/min/mL, while the highest PLA2 activity of fraction number 34 was 52.35 ± 4.73 µmol/min/mL. The protein fractions with the highest activity for each enzyme were further purified by reverse-phase HPLC. This study demonstrates the catalytic activity of the PLA2 and 5NUC from T. rufonigra which may lead to the investigation of therapeutic uses such as antibacterial or anticancer treatments.
S3-3	G2081 16:45-17:00	Coarse-Grained Molecular Dynamics Simulation of Thermostable Starch Branching Enzyme **Kosuke Nariyama**, Yoh Noguchi, Motokuni Nakajima, Hironao Yamada, Ryota Morikawa, Masako Takasu, and Shoko Fujiwara Tokyo University of Pharmacy and Life Sciences, Japan Abstract—Starch Branching Enzyme (SBE) is an enzyme used industrially to improve the water solubility of starch and the stability of its aqueous solution. The optimum temperature at which SBE exhibits enzymatic activity is lower than the temperature at which starch is highly reactive, so improving the thermostability of SBE is being investigated. In previous studies, SBE from Cyanidioschyzon merolae (CmeBE) showed enzymatic activity at higher temperatures than SBE from other organisms, and its thermostability was further improved by introducing an ancestral sequence. Among the CmeBEs with ancestral sequences, the one with the ancestral sequence introduced into BOX2 showed the highest thermostability. In this study, molecular dynamics simulations of the structure of coarse-grained models were performed with wild-type CmeBE and BOX2 mutant-type CmeBE. The analysis showed some differences in the residue 323 substituted from serine to arginine in the wild-type CmeBE and the BOX2 mutant-type CmeBE, suggesting differences in BOX2 reactivity
S3-4	G2010-A 17:00-17:15	Combination of Antimicrobial Peptide Nisin and Doxorubicin Against Breast Cancer Cells **Chanita Phetdee** and Panchika Prangkio Chiang Mai University, Thailand Abstract—Despite advances in cancer therapy, chemotherapy is still ineffective due to drug resistance and severe side effects. Combination of therapeutic agents is an attractive approach to enhance drug efficacy. Nisin, a cationic antimicrobial peptide has been proposed as an alternative anticancer agent and reported for its cytotoxicity against some cancer cells. In this study, anticancer activity of nisin, doxorubicin and both drugs in combination against breast cancer cells were investigated for 24-72 h by MTT assay. As a result, IC50 of nisin were found at 13.67 µM and 2.04 µM for MCF-7 and MDA-MB231 cell lines, respectively. Based on statistical analysis, the synergistic effect between nisin and doxorubicin was markedly observed in MCF-7 when using 10 µM nisin and 1 µM doxorubicin for 24 h of treatment. Furthermore, as demonstrated by fluorescent-based high content analysis, nisin clearly caused cell membrane permeability and promoted doxorubicin-induced DNA damage in both cell lines. Apoptosis was also investigated using annexin-V assay. Altogether, this study demonstrates that the combination of nisin and doxorubicin could enhance anticancer activity and apoptosis in breast cancer cells. Thus,

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		nisin could be potentially used as an alternative for cancer treatment or as an adjuvant to reduce chemotherapeutic drug dosage.
S3-5	G2015-A 17:15-17:30	Development and Characterization of Injectable in Situ Cross-Linked Hyaluronic Acid Hydrogel **Bang Yu Wen**, Ray-Neng Chen, Keng-Sheng Chou, Li-Chuan Fang, and **Ling-Chun Chen** Yuanpei University of Medical Technology, Taiwan Abstract—In recent years, injectable hyaluronic acid hydrogels have been widely used in biomedicine due to their high biocompatibility, biodegradability, and low toxicity. To improve the low mechanical strength and short half-life of cross-linked hyaluronic acid, in this study, we used maleimide (Mal) to modify the carboxyl groups of HA with different degrees of substitution. HA-Mal was combined with the crosslinking agent, 4-arm-PEG-thiol, in various molecular weights to form injectable cross-linked hydrogels with different mechanical strengths. Based on the results, we successfully modified the HA in three degrees of substitution (HM10, HM20, and HM30). In different concentrations and molecular weight ratios of HA-Mal and 4-arm-PEG-thiol, hydrogels showed different mechanical strengths (G' = 500 ~ 3000 Pa). Besides, cross-linked hydrogels performed better degradation rates than commercial products. It is proved hydrogels were tunable and had the potential as a material for drug delivery systems or dermal fillers.
S3-6	G2016-A 17:30-17:45	Quercetin/Fucoidan Nanosystem as Gene Delivery for Synthetical Lethal Synergistic Immunotherapy San-Yuan Chen, **Hung-Wei Cheng**, and Shwu-Jen Chang National Yang Ming Chiao Tung University, Taiwan Abstract—Synthetic lethality is a genetic-level precision medical strategy. By administering corresponding drugs to cancer cells with specific gene mutations, it can cause apoptosis of cancer cells without harming normal cells. Currently, treating BRCA (BReast CAncer) mutated breast or ovarian cancer cells with a chemical inhibitor (Poly ADP-Ribose Polymerase, PARPi) is a typical synthetic lethal application in clinical. In this study, we combined Quercetin, a natural PARP inhibitor, with fucoidan by adjusting the optimal N/P ratio to form quercetin/fucoidan multifunctional gene delivery nanoparticles (Fu/QIO@shPD-L1). In addition, in cellular experiments, we proved that Fu/QIO@shPD-L1 and Fu/QIO@NC both increased the double-stranded DNA breaks and caused apoptosis in BRCA gene-mutated cancer cells. The Fu/QIO@shPD-L1 also successfully reduced PD-L1 expression in cancer cells and did not cause high toxicity to BRCA genetically normal cells. This demonstrated the efficacy of the nanomedicine via synthetic lethality and genetic immunity on BRCA gene-mutated cancer cells. As expected, this multifunctional nanomedicine system will further realize the concept of precision medicine for cancer treatment.
S3-7	G2053-A 17:45-18:00	Increasing Endogenous Hyaluronan Production via Self-Assembled Nanocarriers in Osteoarthritis **Jen-Hao Tsai**, Shwu-Jen Chang, and Chi-Hsiang Wu Shou University, Taiwan

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		Abstract—Osteoarthritis (OA) is a common joint disease that causes synovial fluid loss when tissues are under excessive pressure or metabolic abnormalities. Intra-articular injection of exogenous hyaluronic acid (HA) is an efficient therapy for lubricating joints, absorbing shock and reducing the production of pro-inflammatory factors. However, the treatment may include multiple injections of HA supplements. Furthermore, HA is extracted from bacterial fermentation or animal tissue, which has potential problems with immune responses. To overcome these issues, hyaluronan synthase type 2 (HAS2) is used to stimulate high molecular weight HA production from fibroblast-like synoviocytes (FLS). Nevertheless, the fragile tertiary structure and cell membrane impermeability make HAS2 a big challenge for application. Carboxymethyl-hexanoyl chitosan (CHC) nanocarriers can be effectively used for drug encapsulation without reducing or altering the activity of the drug. In this study, we developed a HAS2-loaded CHC nanocarrier. The results showed that CHC had been synthesized and used to self-assemble into nanoparticles. Particle size could be controlled by CHC concentration and stirring speed. We proposed that this self-assembled nanoparticle could enhance FLS to produce endogenous HA and restore the normal function of synovial fluid for the treatment of OA.
S3-8	G3010-A 18:00-18:15	Silver/Iron Oxide Nanoparticles Decorated Graphene Based Biosensing Platform for Detection of Cancer Exosomes **Jaewook Lee**, Han Sang Kim, Yong-Kyu Lee, Joon Hwang, and Seungrim Hwang Dongguk University, South Korea Abstract—Recently, hybrid nanomaterials have been spotlighted due to their excellent synergic properties. And among of them, nanoparticles decorated carbon nanomaterials have been developed and amazing enhanced properties were shown such as surface-enhanced Raman scattering (SERS), plasmon resonance energy transfer (PRET), fluorescent resonance energy transfer (FRET), magneto optical (MO) effect, and so on. Especially, metallic nanoparticles (NPs) and magnetic NPs modified graphene (GRP) structures were used in various fields such as drug delivery system (DDS), energy device, sensing platform etc due to their magnetic, plasmonic, catalytic and electrical properties [4,5]. In this study, silver (Ag) NP and iron oxide (IO) NP were attached on the surface of GRP by facile two steps in the D.I water for biosensing platform [6]. The silver NP and GRP have plasmonic property and iron oxide possesses magnetic property, thus this structure can be a magnetoplasmonic substrate for magnetofluoro-immunosensing (MFI) system. Recently, exosome have been considered as excellent biomarkers for diagnosis of cancer. However, exosome based diagnosis technique is very difficult sicne exosome isolation and purification are high cost effect and time-consuming. Therefore, to overcome this kind of issues, we used Ag/IO-GRP in order to isolate the prostate cancer (PC) cell derived exosome from the impurities through external magnetic field. The PC antibody (Ab) was attached on the Ag/IO-GRP by EDC/NHS reaction to capture and isolate the PC exosome from the sample, and such captured exosomes were monitored by dye conjuagated tetraspanin Ab. Depending on the number of PC-exosomes, the fluorescent intensity was changed and as increased the concentration of PC-exosome, fluorescent intensity was also

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		linearly increased. In addition this system exhibited excellent selectivity. Therefore, this hybrid material showed excellent potential for exosome biosensing platform.
S3-9	G3007-A 18:15-18:30	Morinda Lucida (Benth): Candidate Plant for Managing Cancer and its Complications **Godwin Ojochogu Adejo**, Okoyomoh K, and Batari, M Federal University Dutsin-Ma, Nigeria Abstract—Introduction: Considering the huge biodiversity resources in Africa in the face of the ravaging menace of cancer, the search for indigenous candidate plants is most worthwhile. Such plants are expected to be available, abundant, wide-spread, affordable, and most especially, efficacious, in treating cancers and in the successful management of its complications. Preliminary assessments of Morinda lucida Benth, have indicated it as a potential candidate plant for treating cancers and managing its complications in Nigeria. Objectives: The rise in cancer cases in Nigeria is presently alarming and almost becoming a pandemic. While the healthcare system is overstretched and helpless, increasing population now seeks for herbal and alternative remedies. Also, the challenges of cancers are not only with the disease itself, but the various complications that arise during treatment. These complications range from cellular stress, inflammation, swellings, and excruciating pain to liver damages. The ethnobotanical survey of medicinal plants which spanned over 5 years, indicated Morinda lucida as the most potent in our collection, in all the listed criteria. All parts of the Morinda lucida plant was screened in the laboratory, to determine its efficacy in managing cancer and resulting complications. Major findings: Preliminary screening of about 20 medicinal plants through antioxidant levels determination showed Morinda lucida as having the highest free-radical scavenging capacity. The biomarkers of inflammation and cytotoxic effects of its different parts were further studied by in-vitro and ex-vitro procedures. The leaf and bark extracts presented the highest antioxidant activities in 73.1% of the cases. The leaf, bark and root extracts presented anti-inflammatory properties ranging between 75.0% and 100.0% at a low dose of 100mg extract/kg within ninety (90) minutes after administration. The leaf extract presented the most potent cytotoxic property at half-inhibitory concentration (IC50) of 190.13mg/L and 316.20mg/L in both the hatchability assay and lethality assays, respectively. Conclusion/implication: These findings suggest that different parts of Morinda lucida especially the leaves and bark possess significant antioxidant, anti-inflammatory, and cytotoxic/genotoxic properties, at safely lower concentrations to justify possible application in treatment of cancers and in the management of its complications.

Session 4

Session 4: Computer Vision and Image Processing

Time: 16:15-18:30, Jan. 14, 2023 (Saturday), GMT+9
Venue: Room 1204 (2F of Building 1)
ZOOM B: 88926005231, Link: https://us02web.zoom.us/j/88926005231
Session Chair: TBA

S4-1	G0006 16:15-16:30	Using Monocular Depth Estimation for Distance Estimation in a Moving Vehicle Lanz Benedict N. De Guzman and **Aaron Raymond See** Southern Taiwan University of Science and Technology, Taiwan Abstract—Accompanying the increase in demand for autonomous systems and robotic solutions is the increase in the relevance of various depth estimation technologies. Monocular Depth Estimation (MDE) is used to predict distances by generating depth maps using only a single RGB camera. However, without out-of-the-box calibration or ground truth reference for generated depth values from MDE models its use case in practical applications is limited. This research introduces a method of actualizing generated depth map values for different applications. The proposed system involves the utilization of machine vision using YOLO for object detection, followed by the computation of the lens optic algorithms to calculate the distance. Results demonstrated a real-time environment detection and depth estimation solution with more than 90% accuracy for measuring object depth in static environments. Furthermore, the system was also successfully tested in a moving vehicle to provide an estimated distance of surrounding vehicles. In the future, further tests will be done to improve the accuracy and calculation speed for use in car safety.
S4-2	G1002-A 16:30-16:45	Effects of Extended High Frequency on the Sound Transmission in the Human Middle Ear **Tzu-Ching Shih**, You-Cheng Yu, Yi Hsu, and Tang-Chuan Wang China Medical University, Taiwan Abstract—This study used the high-resolution computed-tomography image data to simulate the sound transmission from the outer to the inner ear using the extended high frequency from 8 to 20 kHz. The auditory ossicles, suspensory ligaments, tendons, and manubrium were also considered as isotropic elastic materials with sound pressure level at 90 dB in simulation. Numerical results showed that, the significant displacements of the tympanic membranes for the children, young adult, and old adult groups occurred at 11.5 kHz, and their corresponding displacements were 2.59, 2.47, and 2.21 μm, respectively. Meanwhile, the maximum displacement of the stapes for children, young adult, and old adult groups were 0.31, 0.29, and 0.26 μm, respectively. In contrast, for the extended high frequency (i.e., 8kHz) the maximum displacements of the stapes occurred at 20 kHz, where the maximum displacements of the stapes for children, young adults, and old adults were 5.26, 4.81, and 3.85 nm, respectively. It is obvious that the extended high frequency may affect the sound transmission in the ear. The comprehensive finite element model may provide the new insight into appropriate information to early diagnosis of hearing loss with the extended high frequency.

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S4-3	G0012 16:45-17:00	Image Watermarking Algorithm Based on q-logarithm Component Piyanart Chotikawanid and **Thumrongrat Amornraksa** King Mongkut's University of Technology Thonburi, Thailand Abstract—A new embedding component for image watermarking in the spatial domain is presented in this paper as a solution to copyright protection and to verify the real owner of digital image. The embedding component called q-logarithm is extracted from a host color image, and is used directly to embed watermark information. In the extraction process of the embedded watermark, the original version of non-watermarked component is first estimated from the average value of watermarked components in a small image area, so that the blind watermark extraction can be achieved. The watermarked image's quality is assessed by weight Peak Signal to Noise Ratio (wPSNR), and the extracted watermark's accuracy is assessed by Bit Correction Error (BCR). Investigations for optimal parameters are carried out to obtain q value that gives the most accurate extracted watermark. In the experiments, the performance of the proposed method is compared to the relevant three previous methods. A well-known benchmark called Stirmark is also used to assess the robustness of the embedded watermark. It is shown accordingly that the proposed method can achieve better performance in terms of accuracy and robustness even under attacks.
S4-4	G0018 17:00-17:15	Determining Region Color by Using Maximum Colorfulness **Youngha Chang** and Suguru Saito Tokyo City University, Japan Abstract—In recent years, color naming has been widely used as one of the object attributes or image region features. However, estimating appropriate color names is difficult even for singlecolor objects because the lightness and colorfulness of pixels often vary by the highlight and shade. This paper proposes a simple yet robust method to estimate the color name of a given region. Our algorithm utilizes the color distribution of the image region. Specifically, our method first estimates the main hue of the region in the CIECAM16 color space. Then it examines the colorfulness distribution of pixels with the main hue. Our algorithm determines the representative colorfulness and lightness using this distribution. Finally, it proceeds the categorical color naming in the CIECAM16 color space. Compared with the mean color of the region, our method can produce more saturated colors. Our proposed method is applicable to various applications, such as image retrieval, image indexing, object attribute recognition, and color transformation.
S4-5	G0010 17:15-17:30	Evaluation of Illumination in 3D Scenes Based on Heat Maps Comparison **Aleksandr V. Mezhenin**, Vera V. Izvozchikova, and Ivan A. Mezhenin Orenburg State University, Russia Abstract—The issues of assessing the quality of lighting computer 3D scenes using different lighting systems are considered. Quality lighting increases realism, immersion and improves the perception of shape, color and texture of objects in the image. Existing engineering professional lighting calculation programs are not well suited to the design,

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		art solutions or gaming scenes. To obtain objective estimates of illumination, we propose to use metrics for evaluating the quality of rendering systems. Particular attention is paid to the use of such tools as heat maps. Their visual analysis by hue or intensity helps to compare and evaluate the quality of illumination of scenes. However, such a comparison does not give a cumulative score. A possible solution is to treat heat maps as images and use them as the basis for a generalized heat map to produce a single cumulative statistic. In order to create a generalized heat map, several ways of constructing a difference matrix based on normalization methods have been proposed. The proposed approach is implemented as a prototype application. Experiments were carried out on test scenes with different illumination systems. The generalized heat maps made it possible to obtain cumulative estimates of the comparison of different lighting approaches and to identify areas most sensitive to changes in illumination. According to the authors, the proposed approach to illuminance estimation for staged lighting can be used to improve the realism of visualization in 3D modeling.
S4-6	G0014 17:30-17:45	Plant Seedling Classification in Harsh Environment using Preprocessed Deep CNN **Ghazanfar Latif**, Jaafar Alghazo, and Mohammad Zikria Prince Mohammad bin Fahd University, Saudi Arabia Abstract—In developing and developed countries, farmers are struggling to reduce costs and provide organic produce. Farming large areas of land requires equipment, workers, and other material that burden farmers with increased costs to compete in the local, regional, and global markets. With the advent of new technologies in the field of Artificial Intelligence, Internet of Things (IoT), cloud computing, and others, there is a glimpse of hope for inventing new techniques in farming that will eventually reduce the cost of farming large areas of land. In this paper, a method is proposed that can automatically classify plant seedlings with great accuracy thus making it possible for automatic farming processes. In this paper, we propose a Deep CNN architecture for the automatic classification of plant seedlings using whole images and using segmented images as input. The test accuracies achieved outperform similar methods reported in previous studies. The experiments showed that the proposed method achieved an average accuracy of 97.27% when whole images are used as input and an average accuracy of 99.52% when segmented images are used as input to the proposed Deep CNN architecture. The segmented images increased the accuracy by 2.25%. The proposed Deep CNN architecture results are impressive for both cases of using whole images or segmented images as input. The dataset used in this work consists of 5000 images of 12 different species which are captured at various development phases
S4-7	G0015-A 17:45-18:00	A Security-enhanced Steganography Scheme for RGBE_x005f format HDR Images **Tzung-Her Chen** and Jing-Ya Yan National Chiayi University, Taiwan Abstract—Recently, the research of introducing data hiding techniques to High Dynamic Range (HDR) images has drawn much attention in academia. Yu et al. utilizes the homogeneity in RGBE format, one popular format of HDR, to propose a steganography

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		scheme. The attractive contribution of Yu et al.'s scheme is the cover images are demonstrated only with slight and ignorable distortions after embedding. Unfortunately, Yu et al.'s steganography scheme may potentially lead an eavesdropper to arise suspicions because of the multiplication and division in the embedding process causing the abnormal distribution of pixel values. In this paper, an enhanced steganography scheme is proposed to avoid the potential security weakness by post-process: using additional random numbers to change the value of pixels. The experimental results accordingly show that the proposed scheme does improve the security level while achieving reasonable imperceptibility.
S4-8	G0016 18:00-18:15	The Development of the Korat Boxing Digital Museum with 3D Animation Using Inertial Motion Capture Techniques for Preserving the Ancient Martial Arts **Thawatphong Phithak**, Kunlachat Thainchanam, and Sorachai Kamollimsakul Suranaree University of Technology, Thailand Abstract— Korat Boxing or Muay Korat is a unique ancient martial art that originated in Nakhon Ratchasima, Thailand. Up to this point, there has been limited concrete effort to conserve knowledge of Muay Korat. Since knowledge of Muay Korat has mainly been transmitted person to person the general public has limited access or awareness. It is believed that knowledge of this distinct martial art is worth preserving before it becomes irretrievable. This research aims to 1) study and consolidate knowledge of Muay Korat in the form of digital media and 2) design and develop 3D animation of Muay Korat for a digital museum. The researcher used a inertial motion capture machine to record the movements of boxing teachers to create realistic 3D animations of Muay Korat moves, a total of 47 moves. After that, a digital museum was designed and developed which can be accessed via www.muaykorat.info. The digital museum was evaluated for usability testing, using a 5-point Likert scale questionnaire with 6 aspects. The questionnaire was completed by 70 people interested in sports. The results gave excellent scores for 3 aspects, including content and language use ($\bar{X}$ = 4.65); text ($\bar{X}$ = 4.61); and the animation and multimedia presentation ($\bar{X}$ = 4.56). The assessment result for all aspects ($\bar{X}$ = 4.53) implies that the usability of the Korat Boxing Digital Museum is very good. This result is consistent with the overall satisfaction assessment also being very good ($\bar{X}$ = 4.51). In addition, an assessment of the media exposure to digital museum users revealed that Korat Boxing Digital Museum could enhance knowledge and understanding about Korat Boxing at the highest level.
S4-9	G0013 18:15-18:30	Detection of Forest Fire and Smoke from Drone Surveillance Video Using Optical Flow Algorithm **S.Vasavi**, V.Sri Chandana, and Wendy Flores Fuentes Siddhartha Engineering College, India Abstract—Unmanned Aerial Vehicles (UAVs), sometimes known as drones, don't require a pilot or an operator and may transport passengers. They are outfitted with a base control station and a mechanism for communicating with the drone. To identify and locate forest fires, unmanned drones are being utilized to undertake aerial monitoring of forests. Even

		though different deep learning algorithms and image processing frameworks are used to construct a robust system for identifying wildfire and smoke from UAV photos, they face challenges to distinguish fire and smoke, feature loss, cluttered features, small object detection, performance degradation. Using deep learning techniques, this study presents an automated forest monitoring system for detecting smoke and forest fires in drone-based footage. Faster RCNN, for example, is the fastest R-CNN model. For object identification, a Faster-RCNN is employed. Due to the Region Proposal Network, it is quicker than Fast R-CNN. The model used in this work was pre-built by Detectron2. The model was trained on benchmark dataset consisting of 10 videos with 1000 key frames for aerial forest fire and smoke detection. This model showed high accuracy in detecting the elements in the images up to 99%.

Poster Session

Poster Session: Bioinformatics, Biochemistry and Bioscience

Time: 13:40-18:30, Jan. 14, 2023 (Saturday), GMT+9
Venue: Room 1205 (2F of Building 1)

P-1	G2028-A	Role of Pyroglutamic Acid in Cumulus Cells of Women with Polycystic Ovary Syndrome **Bongkoch Turathum**, Feng Yang, Er-Meng Gao, Yi-Bing Liu, Zhi-Yong Yang, Chen-Chen Liu, Yun-Jing Xue, Meng-Hua Wu, Ling Wang, Khwanthana Grataitong, and Ri-Cheng Chian Navamindradhiraj University, Thailand Abstract—Polycystic ovary syndrome (PCOS) is a heterogeneous endocrine disorder associated with established metabolic abnormalities and is a common cause of infertility in females. Glutathione metabolism in the cumulus cells of women with PCOS may be correlated to quality of oocytes for infertility treatment; therefore, we used a metabolomics approach to examine changes in CCs from women with PCOS and oocyte quality. CCs were collected from 43 women with PCOS and 92 without and levels of pyroglutamic acid were measured using LC–MS/MS followed by qPCR and Western blot analysis to examine genes and proteins involved in pyroglutamic acid metabolism related to glutathione synthesis. Women with PCOS showed increased levels of L-pyroglutamic acid, L-glutamate, and L-phenylalanine and decreased levels of Cys–Gly and N-acetyl-L-methionine. Gene expression of OPLAH, involved in pyroglutamic synthesis, was significantly increased in women with PCOS compared with those without. Gene expression of GSS was significantly decreased in women with PCOS and synthesis of glutathione synthetase protein was decreased. Expression of nuclear factor erythroid 2–related factor 2, involved in resistance oxidative stress, was significantly increased in women with PCOS. CCs of women with PCOS showed high concentrations of pyroglutamic acid and reduced glutathione synthesis, which causes oxidative stress in CCs, suggesting that decreased glutathione synthesis due to high levels of pyroglutamic acid in CCs may be related to quality of oocytes in women with PCOS.
P-2	G2032-A	A Text Mining-Based Gene-Disease Association Curation System for Neurodegenerative Disease **JHeonwoo Lee**, Junki Lee, Sungmoon Kim, Jungim Won, Yunjoong Kim, and Jeehee Yoon Hallym University, South Korea Abstract—The identification of gene-disease association is very important in clinical research as it serves as a basis of precision medicine. However, most of the gene-disease association data are buried in the biomedical literature in textual form. We propose a deep learning system, which allows users to retrieve gene-disease associations identified in PubMed paper's title and abstract and curators to curate gene-disease associations while browsing the supporting evidences. In this study, we used neurodegenerative disease as the target and developed a deep learning model using Bidirectional Gated Recurrent Unit (BiGRU) networks and BioWordVec word embeddings for predicting gene-disease associations from biomedical texts. Our curation system provides a user-friendly method for accessing deep learning-based supporting information and a concise interface to assist curators while they are browsing the PubMed articles. The system is web-based and its user interface uses a mixture of HTML and JavaScript.
P-3	G2023	Efficient Feature Selection Using Soft Cluster Analysis for Biological Datasets **Hungyi Lin** and Tinghan Lin

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		National Taichung University of Science and Technology, Taiwan Abstract—The goal of this paper is to propose a new feature selection model which enhances the discrimination power of the selected feature subsets and minimizes their size of them. The proposed algorithm is capable of exploring the essential factors of classification problems for molecular datasets comprising a tremendous amount of input variables. Our model devotes to two accomplishments of multi-class classification tasks. Feature discretization using fuzzy clustering analysis for the improvement of feature discrimination is the first. Multivariate analysis for the investigation of information relevance and redundancy is the second achievement in this study. Experimental results convince our model acquires significant discrimination improvement for microarray classification problems.
P-4	G2062-A	Comparative Genomics of Brain-Eating Amoeba: Balamuthia Mandrillaris **Cherie Tsz-Yiu Law**, Thirapa Nivesvivat, Qing Xiong, Kasem Kulkeaw, Patsharaporn T. Sarasombath, and Stephen Kwok-Wing Tsui The Chinese University of Hong Kong, Hong Kong Abstract—Balamuthia (B.) mandrillaris is a free-living amoeba that can cause rare yet fatal granulomatous amoebic encephalitis (GAE). However, efficacious treatment for GAE is currently unavailable especially when genomic studies on B. mandrillaris are limited. In this study, B. mandrillaris strain KM-20 was isolated from the brain tissue of a 4-year-old Thai girl diagnosed with GAE and its mitochondrial genome was de novo assembled using high-coverage Nanopore long reads. Phylogenetic and comparative analysis revealed the high diversification in the mitochondrial genome of B. mandrillaris KM-20 and nine other strains. The major diversification was caused by an array of novel and variable protein tandem repeats encoded by the ribosomal protein S3 (rps3) gene. The repeating units in the rps3 protein tandem region present significant copy number variation (CNV) among B. mandrillaris strains and suggest KM-20 as the most divergent strain for its highly variable sequence and highest copy number in rps3. Moreover, mitochondrial heteroplasmy was observed in strain V039 and two genotypes of rps3 are caused by the CNV in the tandem repeats. Taken together, the copy-number and sequence variations of the protein tandem repeats enable rps3 to be a perfect target for clinical genotyping assay for B. mandrillaris. The mitochondrial genome diversity of B. mandrillaris paves the way to investigate the phylogeny and diversification of pathogenic amoebae.
P-5	G2071-A	iDMET: Network-Based Approach for Integrating Differential Analysis of Cancer Metabolomics **Rira Matsuta**, Hiroyuki Yamamoto, Masaru Tomita, and Rintaro Saito Keio University, Japan Abstract—Comprehensive metabolomic analyses have been conducted in various institutes and a large amount of metabolomic data are now publicly available. To help fully exploit such data and facilitate their interpretation, metabolomic data obtained from different facilities and different samples should be integrated and compared. However, large-scale integration of such data for biological discovery is challenging given that they are obtained from various types of sample at different facilities and by different measurement techniques, and the target metabolites and sensitivities to detect them also differ from study to study. We developed iDMET, a network-based

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		approach to integrate metabolomic data from different studies based on the differential metabolomic profiles between two groups, instead of the metabolite profiles themselves. As an application, we collected cancer metabolomic data from 27 previously published studies and integrated them using iDMET. A pair of metabolomic changes observed in the same disease from two studies were successfully connected in the network, and a new association between two drugs that may have similar effects on the metabolic reactions was discovered. We believe that iDMET is an efficient tool for integrating heterogeneous metabolomic data and discovering novel relationships between biological phenomena.
P-6	G2064-A	Comparative Genomics of Group 7 Allergens (Bactericidal/Permeability-Increasing Proteins) in Astigmatic Mite Evolution **Fu-Kiu Ao**, Qing Xiong, and Stephen Kwok-wing Tsui The Chinese University of Hong Kong, Hong Kong Abstract—Astigmatic mites are aeroallergens containing multiple allergen groups playing an essential role in allergic diseases (asthma, rhinitis, and atopic dermatitis). On the other hand, the mechanisms by which these mites evolve and acquire allergenicity remained ambiguous, especially for some least well-studied allergens like group 7 allergens. Utilizing high-quality assembled and annotated genomes and transcriptomes of six astigmatic mites, this study examined group 7 allergens, a group of less well-studied proteins belonging to the gene family of bactericidal/permeability-increasing protein (BPI), exerting its effects primarily on airway muscles for allergy, particularly in asthma. The results have delineated the evolutionary aspects of the BPI gene family and the origin of group 7 allergens. The genomes of the six astigmatic mites are compared by means of sequence alignment, synteny, phylogenetic trees, and expression level quantification. The divergence of the six mites was observed regarding mutations, duplications, and gene loss, which also revealed the potential interactions of BPI with hormones. With the results from the comparative study, we can better visualize group 7 allergens at the genomic level, which can guide future clinical studies, leading to more precise diagnosis and treatment for mite allergy for better prognostic outcomes in patients.
P-7	G2033-A	Cognitive Decline Prediction in Parkinson'S Disease Using Moca and Genetic Measures **Junbeom Jeon**, Kyeongmin Baek, Kiyong Kim, Keonbae Lee, and Jeehee Yoon Hallym University, South Korea Abstract—Cognitive decline is one of the most debilitating and pervasive non-motor symptoms of Parkinson's disease (PD). However, the patterns of cognitive progression in PD remain unclear due to the heterogeneity of symptoms and lack of clear predictive models. Identifying valid features that can track the progression of cognitive decline has recently received increasing attentions in PD research community. We employed a multi-task learning regression model for prediction of cognitive status at one future time point. We then use the model to evaluate features related to patterns of cognitive progression on the Parkinson's Progression Markers Initiative (PPMI) database. Age, disease duration, and education_ years were the primary biological features associated with cognitive status. The cognitive test scores of the Montreal Cognitive Assessment (MoCA) which assesses different cognitive domains were better predictors. In addition to these clinical features, the presences of high-risk mutations shared with Alzheimer's disease were also included as

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		predictors in the regression model
P-8	G2035-A	Stephania Oblata Craib Tuber Extract Inhibits Cholangiocarcinoma Cell Migration in Vitro **Apaporn Menakongka** and Sukanda Chaiyong Navamindradhiraj University, Thailand Abstract—Cancer cell migration is the initial step of invasion and metastasis process. The major problem of cholangiocarcinoma (CCA), bile duct cancer, is that most of diagnostic CCA cases are associated with intrahepatic or lymph node metastasis. Stephania oblata Craib has been reported as a medicinal plant traditionally used with various therapeutic properties. Our previous study reported that ethanolic extract of S. oblata strongly reduced KKU-213 cell survival. However, the exact anti-migration mechanisms of this plant extracts on cholangiocarcinoma cells are still unrevealed. Here the effect of S. oblata extract on cell migration was determined. Wound healing assay was used for investigating the effects of plant crude extracts on KKU-213 cell migration. Treatment of the cell with various concentration of S. oblata extract for 6 h resulted in dose dependently reduced cell migration while cytotoxic test with MTT assay was not affected. At 200 µg/mL of extract, wound closure was inhibited by 65 % while cell survival was marginally reduced. The active anti-migration components of S. oblata crude extracts will be identified for the potential development of novel anti-metastatic agent.
P-9	G2069-A	High-Throughput Drug Screening Using 3D Tumor Model Containing Induced Cancer-Associated Fibroblasts for Pancreatic Ductal Adenocarcinoma Treatment **Xiaoyu Song** and Yasuyuki Kida University of Tsukuba, Japan Abstract—Pancreatic ductal adenocarcinoma (PDAC) is a refractory solid cancer presenting as an advanced malignancy. To optimize the treatment of PDAC, high-throughput 3D models that screen thousands of drug candidates are urgently needed. However, commonly used 3D models lack the reproduction of tumor microenvironment, including cellular heterogeneity and its reciprocal signaling. To solve it, we are targeting cancer-associated fibroblasts (CAFs), which serve as the key component of the PDAC tumor environment and contribute to tumor proliferation, cellular heterogeneity, reciprocal signaling, as well as drug resistance. In our previous study, heterogeneous CAFs were established in vitro and in vivo by co-culturing adipose-derived Mesenchyme Stem Cells (MSCs) and PDAC cells. Following this strategy, in this study, to further reproduce the high density and stiffness of PDAC, we are using the fibroblast-populated collagen lattice model to establish a stromal-rich microenvironment. We demonstrated a clinical-like PDAC morphology in this 3D model by H&E staining. To understand the detailed molecularity, immunostaining and ELISA will be performed. At the later stage of this study, we expect this 3D tumor model could be applied for rapid and large-scale drug screening, which may shorten the process of clinicalization and time to market.
P-10	G2066-A	Inhibitory Effect of Sesamin on T cell Activation and its Therapeutic Effect on Atopic Dermatitis **Hyun-Su Lee** Daegu Catholic University School of Medicine, South Korea Abstract—Sesamin, a fat-soluble lignan from extract of Sesamum indicum seed, has been

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		investigated as an anti-inflammatory and immunomodulatory bioactivity; however, few studies have shown its suppressive effect on T-cell activation and T-cell mediated disorders including atopic dermatitis (AD). This study investigated the therapeutic potential of sesamin in AD by controlling T-cell activation with molecular mechanisms. Sesamin decreased the expression of IL-2 mRNA in stimulated Jurkat T cells using anti-CD3/CD28 antibodies, PMA/A23187 and superantigen-loaded Raji B cells. Results from CCK assay and PI staining assay showed that treatment with sesamin has no cytotoxicity in resting and activated condition on Jurkat T cells. In silico analysis to predict target proteins of sesamin on T cells revealed that sesamin physically interact with myeloid cell leukemia sequence 1 (MCL-1) with high score. Moreover, oral administration of sesamin alleviated the symptoms of atopic dermatitis (AD), including ear thickness, scratching number, sizes and weight of draining lymph nodes. Therefore, we suggest that sesamin has therapeutic potential for treating AD with underlying mechanism involved in regulation of MCL-1 activity on activated T cells.
P-11	G2079-A	Chicken Meat Byproduct Hydrolysate Prevented Acetaminophen Induced Hepatitis in Murine Model Zhuo-En Tsai and **Chang-Chi Hsieh** Tunghai University, Taiwan Abstract—In this study, we used chicken meat byproduct for enzymatic hydrolysis and administered this hydrolysate against APAP-induced hepatitis in the murine model. Seventy-five (6-week-old) BALB/c mice were used in this study, including naive group (untreated), control group (APAP modeling), low-dose group (APAP modeling, administered 50 mg/kg chicken hydrolysate), and high-dose group (APAP modeling, administered 200 mg/kg chicken hydrolysate), positive control group (50 mg/kg carnosine). After administering both doses of chicken hydrolysate for one weeks, APAP at 300 mg/kg was administered via intraperitoneal injection and sacrificed after 24 hours. Serum AST, ALT, CRP and ALP were analyzed for hepatoprotective effect. Further inflammatory and oxidative mediators were analysis including IL-6, IL-22, MCP-1, GSH, SOD and GPX in liver homogenate. Results showed that APAP significantly increased ALT and AST which indicated hepatitis. However, administered chicken hydrolysate significantly decreased AST, ALT, IL-6 and MCP-1 levels, and increased IL-22 and GSH levels. H&E staining confirms that chicken hydrolysate can significantly decrease hepatitis induced by APAP. In conclusion, chicken hydrolysate can be effectively protected against APAP-induced hepatitis via reduced inflammatory and oxidative effect.
P-12	G2020-A	Wearable Photomedicine for Melanoma Cancer Treatment using High-Power Parallel stacked OLED Patch Young Woo Kim, Ye Ji Shin, DongWoon Lee, Eou-Sik Cho, Sang Jik Kwon, and **Yongmin Jeon** Gachon University, South Korea Abstract—With the growing interest in health, the demand for real-time health care and treatment using wearable electronic devices is increasing. In particular, light-based health care is being applied in various photomedicine fields such as photobiomodulation (PBM) and photodynamic therapy (PDT) due to its non-invasive and safe advantages. However, previous photomedicine using a light emitting- diode (LED), which is a point light source, showed limitations in wearable platform application due to problems such as non-uniformity, heat generation, and inflexibility. In this study, we report a wearable photomedicine that can be attached to humans through a flexible high-power organic light- emitting diode (OLED) patch platform. The OLED patch platform is made up of a

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		flexible parallel- stacked OLED, a flexible battery, and a flexible patch, making it very thin (< 1mm) and light (< 1g). The OLED patch realized LED-level high output (> 60 mW/cm2) by utilizing a parallel stacked structure. Based on the performance of high-power OLED, singlet oxygen, which is directly related to the PDT treatment effect, was effectively formed (> 450%), and the cancer treatment effect of reducing the cell viability of melanoma (> 24%) was confirmed. This high-power OLED-based wearable photomedicine is expected to be applicable to various PDT fields. Acknowledgements: This research was partly supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No. 2022R1F1A1065534), and Korea Institute for Advancement of Technology (KIAT) grant funded by the Korea Government (MOTIE) (No.P0012453, The Competency Development Program for Industry Specialist). Also this research was partly supported by National Research Foundation of Korea(NRF) grant funded by the Korea government(MSIT) (No. NRF-2022R1A2C1003076).
P-13	G2061-A	Construction and Application of Autonomic Nerve-Innervating Culture Model from Human Pluripotent Stem Cells **Yuzo Takayama**, Yuka Akagi, Yuma Nihashi, Yutaro Kumagai, and Yasuyuki S. Kida National Institute of Advanced Industrial Science and Technology, Japan Abstract—The autonomic nervous systems (ANS) play important roles in the function of various organs in the body. Therefore, construction of co-cultured tissues of neurons in the ANS and other tissues, such as heart or small intestine, induced from human pluripotent stem cells (iPSCs) would be a useful approach for drug discovery applications and disease modeling. In this study, we have developed a technology to induce both sympathetic and parasympathetic neurons, the two types of neurons that compose the ANS, from human iPSCs. Furthermore, we also attempted to construct a co-culture system using induced neurons in the ANS and cardiomyocytes, to confirm the functional connections with induced ANS in vitro.
P-14	G2067-A	Morphometric Study of the Orbicularis Oculi at the Lateral Canthus Level **Mi-Sun Hur** Daegu Catholic University School of Medicine, South Korea Abstract—The aim of this study was to determine the lengths of the orbicularis oculi muscle (OOc) at the lateral canthus level. The OOc was investigated in the 40 hemifaces of 20 Korean cadavers. The lateral fibers of the OOc (OOc lat) extended to the upper lip at the lateral canthus level in 31 of the 40 specimens (77.5%), whereas some inferolateral fibers of the OOc that extended to the upper lip were observed near the level of the lower margin of the OOc in the other 9 specimens (22.5%). The lateral length of the OOc at the lateral canthus level was 33.9±4.4 mm. In the 31 specimens that had OOc lat that extended to the upper lip at the lateral canthus level, the lateral length of the OOc that excluded its fibers that extended to the upper lip at the lateral canthus level was 27.2±4.5 mm. The inferior length of the OOc at the lateral canthus level was 30.5±3.7 mm. The obtained data will be helpful to distinguish the muscles that underlie the skin around the lateral canthus.
P-15	G0007-A	Impingement Cooling of Film Hole Surface Using Transient Liquid Crystal Thermography Image Processing **Wei-Mon Yan**

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		National Taipei University of Technology, Taiwan Abstract—Effects of film hole arrangement and geometry on impingement heat transfer along a film hole surface are experimentally investigated in detail. A transient liquid crystal thermograph with image processing technology has been used in the experiment for present investigation. The image processing is conducted using a digital color camcorder JVC DV (GR-D370TW) and a LCIA image analysis software. The isotherms of red-to-blue transition band were captured through the digital color camcorder and were analyzed with LCIA. The film hole size with four different values, 1.5, 2.0, 2.5, 3.0 mm, jet Reynolds number ranging from 2000 to 4000, and jet-to-target spacing ranging from 1.5 to 4.5 are considered to study the impingement heat transfer performance. In addition, three arrangements of film hole on the target plates, named side-, middle- and staggered-types, are tested, respectively. The experimental results show that the Nusselt number increases with the increase of jet Reynolds number as well as the decrease in jet-to-plate spacing. Better heat transfer can be achieved with larger film hole size. As for the effect of the arrangement of film holes on the target surface, the heat transfer on side-type plate is more significant than the other two for smaller jet-to-plate spacing.
P-16	G2030-A	The Expression of VEGF165 and VEGF165b during Ovarian Follicular Development Chinnarat Changsangfa, **Bongkoch Turathum**, and Khwanthana Grataitong Mahidol University, Thailand Abstract—The ovarian follicular development and ovulatory cycle are depended on angiogenesis and vascular regression. In the ovary, angiogenesis occurs under the control of the vascular endothelial growth factor-A (VEGFA) family of proteins, which are generated as both pro-(VEGF165) and anti (VEGF165b)-angiogenic isoforms by alternative splicing. Estrogen is a necessary hormone to modulate angiogenesis via effects on endothelial cells. To determine the effect of estrogen on the VEGF165, VEGF165b and its receptor (VEGFR2) during ovarian follicular development, we cultured follicular cells that were collected from small, medium and large size of bovine follicles with estrogen and measured VEGF165b, VEGF165 expression by western blot and immunofluorescence. The results showed the expression of VEGF165 was increased in all size of follicles and the expression of VEGF165b was increased in follicular cells of small and large follicle after culture in medium with estrogen. The expression of VEGFR2 was increased in all medium and large of follicle after cultured with estrogen at 96h. VEGF165 was activated at 100 ng/ml estrogen in large follicle at 96 h. In addition, VEGFR2 was also upregulated in all medium and large follicle after treated with 100 ng/ml estrogen at 96 h. This evident suggested that expression of VEGF165 and VEGF receptors associated with estrogen stimulation during development of bovine follicle and in both autocrine or paracrine manner. It revealed the advantage during oocyte maturation in vitro.
P-17	G0011-A	Designing Visual FeedbAack to Assist Facial Exercises in Patients with Parkinsonism **Kyudong Park** and Hyeonsu Kim Kwangwoon University, South Korea Abstract—As we enter an aging society, the number of people with degenerative neurological diseases such as Parkinson's disease is increasing. As an important means for the rehabilitation of these patients, the use of computer vision, artificial intelligence, and computer graphics

		technologies in a mobile environment is being actively discussed. In this study, in order to help facial muscle rehabilitation exercises especially in patients with Parkinson's disease, we design visual feedback that guides motions at landmarks on the face. ML Kit was used to recognize the major landmarks of the face, and visual feedback according to the movement of the face landmarks was implemented in the Android environment. Patients can contract or relax facial muscles while making various facial expressions suggested by the application. As a result of user evaluation, the positive effect of feedback was greater in the elderly. Future research will verify whether the ability of the facial muscles is maintained.

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Session 5: Bioinformatics and Biomedical Sensors for Noninvasive Monitoring

Time: 13:30-16:00, Jan 15, 2023 (Sunday), GMT+9
ZOOM A: 83764998023, Link: https://us02web.zoom.us/j/83764998023
Session Chair: TBA

S5-1	G2024-A 13:30-13:45	A High-Q Surface Plasmon Resonance Chip Design **Jialin Xin**, Ching-Jung Chen, and Jen-Tsai Liu University of Chinese Academy of Sciences, China Abstract—Sensor chips based on localized surface plasmon resonance (LSPR) effects are widely used for chemical and biological analysis. However, the inherent high optical loss and radiation damping of metals hinder the acquisition of high quality factor (high-Q) plasmon resonance. Unlike current commercially available SPR sensor chips, surface-enhanced sensor chips with submicron structures can suppress radiation damping to improve the quality factor of plasmon resonance. This research will use maskless lithography, bi-layer lift-off process and metal film deposition techniques to fabricate a high-Q SPR sensor chip with periodically distributed gold nanorod structures. The results show that the interaction between the submicron array structures can be strongly enhanced by near-field coupling and far-field coupling, resulting in a significant increase in the quality factor and a successful reduction of the plasma loss on the surface of the sensor chip.
S5-2	G3015-A 13:45-14:00	Integrative Analysis of GWAS And Transcriptomics Data Reveal Key Genes for Non-Small Lung Cancer **Xiangxiong Feng** University of California, USA Abstract—Background: Lung cancer is one of the world's most common and deadly cancers. The two main types of lung cancer are non-small cell lung cancer (NSCLC) and small cell lung cancer (SCLC). More than 85% of lung cancer are NSCLC. Genetic factors play a significant role in the risk of NSCLC. Growing studies focus on studying risk factors at the molecular level. The aim of the study is to build a pipeline to integrate Genome-wide association analysis (GWAS) and transcriptomics data with machine learning to effectively identify genetic risk factors of NSCLC. Method: GWAS datasets and GWAS summary data were downloaded from GWAS catalog which include lung carcinoma genetic variants among the European population. Then, with the GWAS summary data functional analysis of significant SNPs was performed using a webserver called FUMAGWAS. The transcriptomics data of NSCLC and non-NSCLC people were used to build a machine learning model to identify the key genes that help predict the NSCLC. Result and Conclusion: The top up-regulation and down-regulation genes were identified by the BART cancer webserver and the mechanistic roles of the genes were validated by literature review. By performing integrative analysis of GWAS and transcriptomics analysis using machine learning, we identified multiple SNPs and genes that related to NSCLC. The computational pipeline may facilitate the biomarker discovery for NSCLC and other

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		diseases.
S5-3	G2022-A 14:00-14:15	A High Specificity Sensor for Rectal Cancer Detection **Tianyi Chen**, Ching-Jung Chen, and Jen-Tsai Liu University of Chinese Academy of Sciences, China Abstract—Biomedical sensors should have sensitivity, resolution, stability, repeatability and other characteristics. These characteristics all point to a characteristic - specificity in medical detection. In the early detection of rectal cancer, we detect fecal occult blood. In order to distinguish the presence of hemoglobin from the complex fecal environment, we must improve the specificity of the sensor. The surface plasmon resonance (SPR) technique we used is a real-time, label free trace detection system. The self-assembled monolayer technology is used to implant the aptamer on the sensor surface. The smooth surface and uniform covering of small molecules ensure a good antifouling property of the interface. The specificity of the aptamer improves the selectivity to hemoglobin. We tested the specificity of the sensor with human serum albumin, bovine serum albumin and lysozyme, which are 3-5 times higher than the human body concentration. In addition, we tested the anti fouling performance of the sensor with a serum diluted 1000 times to simulate a complex environment, proving the high specificity of the modified sensor and the possibility of its clinical application.
S5-4	G2002 14:15-14:30	Genomic and Single Cell Transcriptomic Analyses in Autism Spectrum Disorder **Yijing Li** and Raven Huang The Webb Schools, USA Abstract—Autism Spectrum Disorder (ASD) is a neurological developmental disorder characterized by repetitive behaviors accompanied by communication and social interaction impairment.In this paper, the effect of prenatal stress factors on ASD was investigated by collecting single-cell RNA sequencing and calculation. The results suggest that stress responses, such as obesity-related stress and oxidative stress, may be related to neuronal death and contribute to the development of ASD. In addition, studies have shown that stress response genes decline over time under low temperature conditions.
S5-5	G2031-A 14:30-14:45	Proteome Profiling in Peripheral Blood Mononuclear Cells (Pbmcs) Exposed to High Glucose and Advanced Glycation End Products Reveals Differential Expression in Ubiquitin-Proteasome System **Jarupa Soongsathitanon** and Visith Thongboonkerd Mahidol University, Thailand Abstract—INTRODUCTION: Atherosclerosis represents a leading complication in diabetes. Prolonged hyperglycemia results in the formation of advanced glycation end products (AGEs) which, together with high glucose, induces immune cell dysfunction and causes blood vessel damage. These processes accelerate the development of atherosclerosis in diabetes. This study was designed to investigate how hyperglycemic condition affects proteome profiles of peripheral blood mononuclear cells (PBMCs) under exposure to high glucose and AGEs in vitro. METHODS: PBMCs were isolated from

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		healthy subjects and cultured in 3 conditions: 5 mM glucose (normal glucose; NG), 25 mM glucose (high glucose; HG) and 25mM glucose plus 100 ug/ml AGE-BSA (HG+AGE) for 24 hours. Cellular proteins were subjected to two-dimensional gel electrophoresis. The protein spots were identified by Q-TOF MS and/or MS/MS. RESULTS: Quantitative analysis and statistics revealed 31 protein spots different between NG vs. HG, and 14 protein spots different between HG vs. HG+AGE. Mass spectrometric analyses showed that ubiquitin-like protein 4 (Ubl4a) was significantly upregulated in HG condition compared with NG, whereas the Ubl4a was downregulated in the presence of AGE. These findings were confirmed by Western blotting. DISCUSSION AND CONCLUSION: From our study, we are able to demonstrate differential protein expressions especially the upregulation of ubiquitin-proteasome pathway in high glucose condition. Ubiquitin-proteasome system overactivity has also been shown associated with the inflammatory process of atherosclerosis. Further study in diabetic patients may confirm the proteins in ubiquitin-proteasome system as potent biomarkers and predictors for atherosclerotic complication in diabetes.
S5-6	G3006 14:45-15:00	The Function of Transmembrane Helix and Signal Sequence of Coronavirus in Co-Translational Targeting and Insertion towards ER **Duo Bai** and Qi Xie The Experimental High School Attached to Beijing Normal University, China Abstract—SARS-Cov-2, a type of coronavirus, caused the global pandemic, and the era has yet ended. The coronavirus has a complicated life cycle. Many researchers have investigated the targeting steps to prevent the coronavirus from replicating in human cells, aiming to find an efficient treatment. Here, I focus on the co-translational targeting and insertion of coronavirus structure proteins. I calculated the Kyte-Doolittle hydrophobicity of the coronavirus structure proteins from over 61 species. Based on this, I developed a simple algorism to search the signal sequence and transmembrane helix which is responsible for the co-translational synthesis of the viral proteins. I further calculated the apparent free energy of ΔG_app of membrane insertion and investigated the consensus sequences by multiple sequence alignment using the ClustalOmega algorism. Based on the computational calculations, I found that the transmembrane helixes of S protein and E proteins show extremely high hydrophobicity and low apparent free energy of ΔG_app. I also found that the signal sequence of S protein shows a non-charged characteristic at the N-terminus, which is typical as a signal sequence for membrane targeting. After that, I predicted the second structure, did the molecular docking and found a possible protein to inhibit the protein. This research is important for the understanding of coronavirus assembly on the membrane. Therefore, I hope it provides a new targeting site for the inhibition of coronavirus replication in the host cells.
S5-7	G2026-A 15:00-15:15	A Direct Electron Transfer Paper-Based Glucose Biosensor **Binghuan Zhang**, Yanzhen Jing, Ching-Jung Chen, and Jen-Tsai Liu University of Chinese Academy of Sciences, China Abstract—Blood glucose monitoring is critical to the diagnosis and treatment of diabetes

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		mellitus. Among them, commercial glucometers are invasive and painful due to finger-prick, second-generation glucose biosensors typically require redox mediators, which have potential toxicity and long-term stability issues. However, direct electron transfer（DET）glucose biosensors do not need electron mediators and realize the direct electron transfer between the redox center of the enzyme and the electrode, which has the advantages of strong anti-interference, good biocompatibility and high sensitivity. It was found that nanostructured materials can accelerate DET due to their high conductivity and excellent catalytic activity. Meanwhile, paper-based electrodes are also attracting attention because of their green, low-cost and easy integration advantages. Based on this, this study proposes the preparation of a DET paper-based glucose sensor, the paper-based electrode is prepared by screen printing, and multi-walled carbon nanotubes and redox graphene are used to achieve direct electron transfer between GOD and the surface of the electrode, and the sensing performance is investigated by electrochemical characterization and glucose detection. The flexible electrode has excellent potential for wearable glucose detection.
S5-8	G2076-A 15:15-15:30	Rapid Identification of Transcriptional Mechanism of Action of Phenothiazine Derivatives to Delay Alzheimer's Pathology in C. Elegans **Kun-Hyung Roh** Mt. Sinai School of Medicine, USA Abstract—Alzheimer's Disease (AD) is the most common neurodegenerative disorder and also the leading cause of death in the US. The largest risk factor of AD is aging, and with expansion of human lifespan and aging population, AD is a public health emergency that urgently calls for an effective drug. There are currently no effective drugs approved for this disease due to the lack of understanding of disease pathogenesis and molecular targets. In the quest for blood-brain-barrier-penetrable potential drugs, phenotypic assay on model organism C. elegans was performed, in which phenothiazines were among the most protective drug classes against Aβ42-induced proteotoxicity. C. elegans is an excellent preclinical model organism that discovered compounds to delay human diseases, and some of them successfully reached clinical trials. Phenothiazines significantly reduced TNF-α levels from microglia, a major brain immune cell responsible for neuroinflammation. Prior to this research, it was undefined how phenothiazines can produce such anti-inflammatory, neuroprotective effects. Moreover, the molecular targets that modulate the underlying therapeutic mechanism remained elusive due to many challenges faced by conventional target identification techniques. Here, we demonstrate a first study utilizing a novel computational pharmacogenomic approach to uncover neuroprotective mechanisms of phenothiazines at a transcriptional level, characterizing CREBBP and SP1 transcription factors as central regulators for epigenetic modulation. Through this paper, we contribute to the overall understanding of AD by bridging the gap between genotype and phenotype, nominating therapeutic targets and biomarkers, and most importantly, highlighting that this technique can be applied to any assays in drug discovery labs.
S5-9	G3005	Heterogeneity Analysis of Glioblastoma Tumor Cell Population based on Single-Cell RNA

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	15:30-15:45	Sequencing Data Analysis **Jason Huajue Yang** and Eena Cheng St. George's School, Canada Abstract—Gliomas are lethal cancers that originate in the central nervous system. Glioblastoma multiforme (GBM) is the most aggressive and commonly occurring malignant brain glioma, accounting for just under 50% of all cases of malignant brain tumours in adults. In this paper, glioblastoma tumour cell single-cell RNA sequencing data were analyzed with Seurat, and cell groups were identified by employing various marker genes. Diverse populations of cell types were revealed, including tumour-associated macrophages, microglia, monocytes, t-cells, oligodendrocytes, glioblastoma stem cells, and other progenitor cells. Glioblastoma heterogeneity was also observed, as different samples of glioblastoma possessed distinct cellular compositions. Analysis of phagocytic cell clusters revealed the presence of microglia-like cells that resulted from monocyte differentiation. The upregulation of TIGIT and STAT3 in t-cell clusters was observed in cases with especially low t-cell counts, which demonstrates glioblastoma's immunosuppressive abilities. Furthermore, stem cell count was shown to be exceedingly low in cases of recurrent glioblastoma in comparison to cases of newly-diagnosed glioblastoma. Presumably, tumour recurrence should be caused by stem cells, but the exceptionally low stem cell count in cases of recurrent glioblastoma proves otherwise. This reveals that treatment or surgery should target stem cells in cases of newly developed glioblastoma but should target other factors in cases of recurrent glioblastoma—examples of which include the tumour microenvironment. These results can be used to help create more innovative and effective treatments for glioblastoma multiforme.
S5-10	G2025-A 15:45-16:00	An Adaptive Differential Self-Calibration Algorithm for the Calibration of Non-Invasive Glucose Monitoring Based on Reverse Iontophoresis **Tianyi Sun,** Yuchen Liu, Rencai Liu, and Ching Jung Chen University of Chinese Academy of Sciences, China Abstract—Non-invasive continuous glucose monitoring (CGM) is of great significance for the treatment and prevention of diabetes. Due to the good correlation between the glucose level in interstitial fluid and blood, the non-invasive CGM sensor based on reverse iontophoresis (RI) technology to extract and detect the interstitial fluid has a promising application prospect. However, considering the lack of accuracy and stability, it has not been approved as a commercial technology. Since affected by temperature, sweat interference, and individual skin differences, CGM sensors based on RI cannot guarantee stable extraction under certain conditions. Based on this, this paper proposes an adaptive differential self-calibration algorithm to improve the detection accuracy and stability. By fitting the actual measurement of the skin in the non-extracted area to predict the individual compensation amount of the system in the short term, the ideal measurement value can be obtained through a differential calibration model. On-body continuous glucose monitoring experiments will be carried out under an optimal

		extraction condition. During this period, the measurement trend of the commercial fingertip blood glucose meter and the non-invasive CGM device based on RI extraction will be compared, and the Pearson correlation coefficient will be used to illustrate the effectiveness of the algorithm.

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Session 6: Biomedical Signal and Image Processing

Time: 16:15-18:15, Jan. 15, 2023 (Sunday), GMT+9
ZOOM A: 83764998023, Link: https://us02web.zoom.us/j/83764998023
Session Chair: TBA

S6-1	G3004 16:15-16:30	Classification of Theoretical Extracellular Action Potentials Based on Unsupervised Machine-Learning **Junming Chen** University of Science and Technology Beijing, China Abstract—Extracellular action potentials (EAP) are one of the most important features in biological study. Many researchers have studied the classification of EAP by their differences in voltage and magnitude. However, most research ignored the fundamental origin of the EAP variation around the neurons in their classification and treated waveforms of different shapes as signals recorded from different neurons. In our research, we theoretically investigated the shapes of EAP by clustering the spatially-vaired EAP around the neuron. We use an unsupervised machine-learning algorithm to classify all EAPs measured around the same neuron. To eliminate the influence of the non-characteristic part of the EAP curve, we also compared the classification results by eliminating the unchanged part at the front and end of the curve in the second group of our study. Our results illustrate the previously overlooked relationship between different shaped EAP and the biological structure of the neuron. The results show that EAP measured is more close to classical theory prediction in the axon while more eccentric, even with a shape similar to an intracellular action potential in the dendrite. Our research has important implications for further device design to record accurate electric signals and extracting biological related information from extracellular recordings.
S6-2	G2055 16:30-16:45	A Deep Learning Approach to Infer Morphological Characteristics of the Heart from Cardiac Sound Analysis Rui Camacho, Jorge Oliveira, and **Luís Andrade** Faculdade de Engenharia da Universidade do Porto, Portugal Abstract—As the major cause of deaths worldwide, cardiovascular diseases are responsible for about 17.9 million deaths per year 1. Research on new technologies and methodologies allowed the acquisition of reliable data in several high income countries, however, in various developing countries, due to poverty and common scarcity of resources, this has not been reached yet. In this work, cardiovascular data acquired using cardiac auscultation is going to be used to detect cardiac murmurs through an innovative deep learning approach. The proposed screening algorithm was built using pre-trained models comprising Residual Neural Networks, namely Resnet50, and Visual Geometry Groups, such as VGG16 and VGG19. Furthermore, and up to our knowledge, our proposal is the first one that characterizes heart murmurs based on their frequency components, i.e the murmur pitch. Such analysis may be used to augment the system's capability on

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		detecting heart diseases. A novel decision-making function was also proposed regarding the murmur's pitch. From our experiments, low-pitch murmurs were more difficult to detect, with final f1-score values nearing the 0.40 value mark for all three models, while high-pitch murmurs presented an higher f1-score value of about 0.80. This might be due to the fact that the low-pitch share their respective frequency range with the normal and fundamental heart sounds, therefore making it harder for the model to correctly detect their presence whereas high-pitch murmurs' frequencies distance from the latter.
S6-3	G2038-A 16:45-17:00	Influence of Outer Hair Cell on Tectorial Membrane Waves **Haruki Mizuno**, Tomoya Ueno, Yu Sueyasu, and Toshiaki Kitamura Kansai University, Japan Abstract—This study focuses on the influence of an outer hair cell (OHC) on the waves that propagate on tectorial membrane (TM). The OHCs play a central role in signal amplification in the cochlea. The TM overlies the OHCs. The OHCs are stimulated by shear between the vibrating basilar membrane and the TM. In the previous study, we found that there are two types of slow waves that propagate on the TM. In this study, we consider the analysis model that consists of TM and an OHC. First, we investigated the propagation characteristics of the TM waves. We discussed the influence of the OHC on the phase constants of the TM waves. We found that the influence is significantly different between the two types of TM waves and the TM wave whose displacement concentrates on the tip of the TM main body is strongly affected by the OHC. We also showed the frequency characteristics of the displacement of the OHC.
S6-4	G2047 17:00-17:15	Deep Learning Applications in Fmri–A Review Work **Jiangxue Li** and Peize Zhao University of Chinese Academy of Sciences, China Abstract—In modern neuroscience and clinical research, functional magnetic resonance imaging (fMRI) is a non-invasive imaging technique that uses magnetic resonance imaging to measure hemodynamic changes caused by neuronal activity. This technique is used to study human brain function and cognition in healthy individuals and groups with abnormal brain states. And it is one of the most commonly used imaging modalities. Because of its characteristics of containing temporal information, it is widely used in research in cognitive neuroscience, clinical psychiatry/psychology, and preoperative planning. Advances in artificial intelligence, especially the advent of deep learning techniques have shown promising results for better interpretation of fMRI data. This paper focuses on fMRI data and summarizes the current state of application of deep learning methods and models on resting-state and Task-evoked data. In the future, deep learning combined with advanced feature selection methods or task-state fMRI data has the potential to become a powerful tool for exploring the state and function of the human brain.
S6-5	G0001 17:15-17:30	Evaluating Performances of Attention-Based Merge Architecture Models for Image Captioning in Indian Languages Rahul Tangsali, **Swapnil Chhatre**, Soham Naik, Pranav Bhagwat, and Geetanjali Kale SCTR's Pune Institute of Computer Technology, India

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		Abstract—Image captioning is a growing topic of research in which numerous advancements have been made in the past few years. Deep learning methods have been used extensively for generating textual descriptions of image data. In addition, attention-based image captioning mechanisms have also been proposed, which give state-of-the-art results in image captioning. However, many applications and analyses of these methodologies have not been made in the case of languages from the Indian subcontinent. This paper presents attention-based merge architecture models to achieve accurate captions of images in four Indian languages- Marathi, Kannada, Malayalam, and Tamil. The widely known Flickr8K dataset was used for this project. Pre-trained convolutional neural network (CNN) models and language decoder attention models were implemented, which serve as the components of the merge architecture proposed here. Finally, the accuracy of the generated captions was compared against the gold captions using BLEU (Bilingual Evaluatio Understudy) as an evaluation metric. It was observed that the merge architectures consisting of InceptionV3 give the best results for the languages we test on, the scores discussed in the paper. Highest BLEU-1 scores obtained for each language were: 0.4939 for Marathi, 0.4557 for Kannada, 0.5082 for Malayalam, and 0.5201 for Tamil. Our proposed architectures gave much higher cores than other architectures implemented for these languages.
S6-6	G2070 17:30-17:45	Inner Diameter Measurement Oriented Aortic Segmentation: An Edge Enhancement and Contextual Fusion Deep Learning Method **Di Zhang**, Wenjing Zhang, Tao Luo, Ming Yang, and Aijun Liu Beijing University of Posts and Telecommunications, China Abstract—Coarctation of aorta (CoA) is a critical congenital malformation which can lead to serious complications such as hypertension, heart failure and even shock in severe case. The effective diagnosis and surgical management of CoA require accurate aortic inner diameter measurement mainly based on cardiovascular computed tomography (CT). Due to the traditional manual aortic inner diameter measurement is labor-intensive and susceptible to observer's expertise, the deep learning (DL) enabled aortic segmentation based aortic inner diameter measurement methods have been investigated. However, most existing DL based aortic segmentation methods ignore the edge information and spatial consistency, which lead to poor segmentation performances. To solve this problem, we propose an edge enhancement and contextual fusion network, called ECN, which can enhance edge information and utilize the contextual relationships of CT slices so as to improve aortic segmentation. Simulation results show that the proposed algorithm outperforms the compared DL algorithms in dice score (0.9370) and 95% Hausdorff distance (1.3383mm) in our private patient-specific CoA dataset. Moreover, the proposed ECN based aortic inner diameter measurement achieves low bias and high correlation with the results measured by doctors.
S6-7	G1003 17:45-18:00	Review of Image Guided Radiotherapy **Wenxuan Li** Pennsylvania State University, USA

Session 6

		Abstract—Image guided radiotherapy (known as IGRT) has been a critical tool in the field of radiation oncology which had significantly increased the successful rate of managing cancer. Rather than using traditional radiotherapy techniques, for instance, conventional (or 2D) radiotherapy, the use of 3D even 4D radiotherapy has been made possible due to the technological advances we are achieving in recent years. With the help of advanced imaging technology, not only the precision of dose delivery increased dramatically, but also the toxicity to adjacent tissue decreased. But still, most importantly, many of the aspects of current radiotherapy techniques remained underdeveloped. The review will discuss history of radiotherapy, common types of radiotherapy used, and some future development trends of radiotherapy. It also talks about the advantage and disadvantages each technique has along with improvement leading to the next generation of the more advanced technique being used with a chronological order of invention.
S6-8	G1004 18:00-18:15	Oversampling Facial Motion Features Using the Variational Autoencoder to Estimate Oro-facial Dysfunction Severity **Trassandra Jewelle Ipapo**, Charlize Del Rosario, Raphael Alampay, and Patricia Angela Abu Ateneo de Manila University, Philippines Abstract—Class imbalance, which negatively affects classification model performance, is a common problem with machine learning. Various oversampling methods have been eveloped as potential solutions to compensate for imbalanced data. SMOTE is one of the more common methods employed. However, deep generative models such as the variational autoencoder are showing promise as alternatives to traditional oversampling methods. This study investigated the potential of variational autoencoders in learning the distribution of the minority class and producing new observations of facial motion features extracted from an imbalanced medical dataset as well as to see the effects of oversampling before and after the train-test split. The effectiveness of the variational autoencoder was compared to SMOTE in increasing ordinal classification performance across the metrics of accuracy, accuracy±1, inter-rater reliability, specificity, and sensitivity with no oversampling serving as the baseline. The results show that the variational autoencoder has potential as an oversampling method for facial motion features in the context of oro-facial dysfunction estimation. Oversampling prior to the train-test split was also shown to improve classification performance.

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