BISC Satellite 2021

The 7th Biomedical Imaging and Sensing Conference

主辦單位：國立臺灣大學醫療器材與醫學影像研究所
Organizer NTU Institute of Medical Device and Imaging
國立臺灣大學永齡健康研究院
NTU YongLin Institute of Health
會議地點：國立臺灣大學醫學院202講堂
Venue NTU College of Medicine (R202)
會議時間：2021.04.19 (一) 08:15-17:30
Time April.19 2021 (Mon.) 08:15 a.m.-05:30 p.m.

OPIC OPTICS & PHOTONICS International Congress 2021
SPIE. The international society for optics and photonics
國立臺灣大學 永齡健康研究院 NTU YongLin Institute of Health
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Session A：Biomedical Application I		
08:30~09:00	**Prof. Jean-Marc EGLY** (Academician of French Science Academy) **Title:** ***Imaging and molecular defects in transcription syndromes***	**Prof. Kung-Bin SUNG**
09:00~09:30	**Prof. Huei-Wen CHEN** (National Taiwan University) **Title:** ***Image-based high content analysis on discovering anti-cancer drug targeting cancer stemness niche***	
09:30~10:00	**Prof. Yeun-Chung CHANG** (NTUH Department of Medical Imaging) **Title:** ***CT radiomics of lung cancer***	
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Session B：Optical Coherent Tomography		
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10:45~11:15	**Prof. Meng-Tsan TSAI** (Chang Gung University) **Title:** ***OCT/OCTA-guided laser ablation for tumor treatment***	
11:15~11:45	**Prof. Hsiang-Chieh LEE** (National Taiwan University) **Title:** ***A pilot study of developing a small footprint imaging platform with optical coherence tomography (OCT) and OCT angiography for mouse brain imaging in vivo***	
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2021/04/19 (Mon.)		
Time	**Title**	**Presider**
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13:30~14:00	**Prof. S-Ja TSENG** (National Taiwan University) **Title:** ***New treatment opportunities for drug resistance in non-small cell lung cancer***	
14:00~14:30	**Prof. Gary Han CHANG** (National Taiwan University) **Title:** ***Morphological biomarker of osteoarthritis knees by deep learning***	
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15:45~16:15	**Prof. Chia-Lung HSIEH** (Academia Sinica) **Title:** ***High-speed dynamic cell imaging by scattering-based interference optical microscopy***	
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16:45~17:15	**Prof. Shi-Wei CHU** (National Taiwan University) **Title:** ***High-speed volumetric imaging for brain***	

Jean-Marc Egly

(Ph.D, Louis-Pasteur University,French)
Academician of French Science Academy

Imaging and molecular defects in transcription syndromes

The remarkable biochemical advances in gene expression regulation provided insights in the pathogeny of up to 20 genetic disorders related to mutations within components of the transcription machinery requested to read any genes. We dissected the molecular defects (some of them visualized by confocal and immunostaining) that lead at least in part, to the development of clinical features observed in patients with xeroderma pigmentosum (XP), trichothiodystrophy (TTD), Cockayne syndrome (CS), Opitz Caveggia, etc.... For example, we showed that hypoplasia of the adipose tissue and demyelination of the central nervous system in TTD reside in impaired transactivation mediated by the nuclear hormone receptors responsive genes. We also demonstrated that Cockayne's syndrome-related mutations in the CSA and CSB proteins prevent the removal of the gene repressor ATF3, and consequently the restart of transcription post-cellular (such as UV, Heat-Shock stress) as well as a defect in the separation of the two daughter cells during cell division.

Huei-Wen Chen

(Ph.D, National Taiwan University)
National Taiwan University

Image-based high content analysis on discovering anti-cancer drug targeting cancer stemness niche

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The tumourous microenvironment (TME) and intra-tumourous heterogeneity may fuel the cancer cell plasticity and evolution. We established a lung cancer stem cells (CSCs) and cancer-associated fibroblasts (CAFs) co-cultured system, a niche-based model to mimic the TME of patients and developed the image-based high-throughput drug screening with phenotypical parameters and stemness markers. We identified compounds that significantly reduce the CSCs subpopulation both in vitro and in vivo, including the patient-derived xenograft (PDX) models and showed therapeutic efficacy in combination with cisplatin or paclitaxel. Novel pharmacological mechanisms on niche-dependent paracrine machinery in CAFs and YAP1 in lung CSCs were identified. This CSCs/CAFs drug screening model proposes a new method to identify leads targeting lung CSCs and/or the niche, may accelerate the new anti-cancer drug development and benefit for precision medicine.

Yeun-Chung Chang
(M.D/Ph.D, National Taiwan University)
National Taiwan University Hospital

CT radiomics of lung cancer

Lung cancer is the leading cause of cancer-related mortality worldwide with only an average five-year survival rate of around 19%. To provide adequate therapy for lung cancer, TNM staging has been widely used for supporting treatment management. Given the tumor size as the main measurable parameter of initial tumor stage and follow up strategy, some limitations are noted accordingly because tumor size alone does not sufficient to reflect to internal characteristics of lung cancer. Therefore, histopathological subtyping and gene mutation analysis are important to improve the management decision and outcome prediction.

Sheng-Lung Huang

(Ph.D, University of Maryland,USA)

National Taiwan University

Deep learning empowered cellular-resolution optical coherence tomography

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Cellular-resolution optical coherence tomography (OCT) could help unveil living organisms' functions and facilitate clinical disease/cancer diagnosis in the early stage. The cell size, orientation, and morphology are critical indicators to discriminate between normal and cancer cells. In this talk, deep learning algorithms for detecting/segmenting the crucial cell/tissue/lesion features, such as nuclei, the dermal-epidermal junction of human skin, and tumor boundaries, will be addressed. The performance can be explained by visualizing the neural network's feature activations in response to the cell-like structure of human tissues. Both morphological recognition and machine learning using the backscattering from the subcellular structures will be addressed. Leveraging the ever-escalating techniques in applying deep learning algorithms to OCT analysis could accelerate the acceptance among clinicians and patients.

Meng-Tsan Tsai

(Ph.D, National Taiwan University)

Chang Gung University

OCT/OCTA-guided laser ablation for tumor treatment

Laser ablation has come an alternative solution for tumor treatment, and it can be used to remove or shrink tumor tissue. In the previous reports, the pulsed lasers are the most common laser as the light source of laser treatment due to the controllable thermal damage, but it is difficult to use continuous-wave (CW) lasers for tissue ablation because of unpredictable laser damage and thermal effect. Typically, the CW lasers are cost effective in comparison to the pulsed lasers. Additionally, it is also challenging to accurately identify the tumor region for laser therapy to avoid the extra damage on the surrounding tissue. To overcome the limitation of using CW lasers for tumor therapy and to identify the tumor region for laser therapy, an imaging method to monitor the thermal effect induced by the CW laser in real time and to distinguish the tumor region is required.

Hsiang-Chieh Lee

(Ph.D, Massachusetts Institute of Technology,USA)
National Taiwan University

A pilot study of developing a small footprint imaging platform with optical coherence tomography OCT and OCT angiography for mouse brain imaging in vivo

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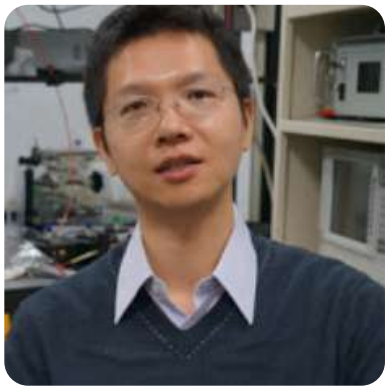
Various technologies have been applied to investigate the mechanism of cerebral autoregulation with the mouse brain model, including neurovascular coupling where the changes in the blood oxygenation and blood volume, for example, represent the response to the changes in neural activity. Although magnetic resonance imaging allows volumetric imaging of the mouse brain, both the spatial and temporal resolution are limited, which might not be feasible to identify the fine brain microvascular network. In this study, we have developed an imaging platform that allows volumetric imaging of brain architectures and the microvasculature with optical coherence tomography (OCT) and OCT angiography techniques.



Sheng-Hao Tseng

(Ph.D, University of California,USA)

National Cheng Kung University

Noninvasive quantification of neonatal bilirubin and hemoglobin levels using a handheld diffuse reflectance spectroscopy system

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The prevalence rates of neonatal jaundice and anemia could reach 80% and 25%, respectively. We have developed a handheld diffuse reflectance spectroscopy system to noninvasively, accurately determine the bilirubin and hemoglobin levels of neonates.

S-Ja Tseng

(Ph.D, National Tsing Hua University)
National Taiwan University

New treatment opportunities for drug resistance in non-small cell lung cancer

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TTherapeutic outcomes in treating non-small cell lung cancer (NSCLC) are compromised by the emergence of drug resistance in response to epidermal growth factor receptor (EGFR)-tyrosine kinase inhibitor (TKI) targeted therapy. Clinical virotherapy has been successfully approved for use in cancer treatment by the US Food and Drug Administration (FDA), however a number of improvements are still sought to more broadly develop virotherapy. To achieve this however, a technique is required that delivers the virus to tumor before the body's natural self defense eradicates the virus prematurely. Our nano-modified virotherapy with targeting abilities has been proposed for EGFR-TKI-resistant NSCLC treatment and has already achieved success in in vitro or in vivo models.

Gary Han Chang

(Ph.D, University of Massachusetts Amherst,USA)
National Taiwan University

Morphological biomarker of osteoarthritis knees by deep learning

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MRI-based morphology of femorotibial joints has shown great promise in prediction of osteoarthritis risk and progression, albeit detailed segmentation of femorotibial joints in large volume remains to be difficult. In this work, we developed a morphological biomarker which reflect the changes in bone and cartilage shapes from knee MRI images using deep learning (DL). Utilizing contrastive learning and fully-connected neural network, the DL model learned to focus on the subtle changes in bone and cartilage shapes, especially the denuded bone area. We demonstrated that this novel biomarker is highly representative of the morphological changes in the femorotibial joints and indicates the short- and long-term progression of OA symptoms of patients, as well as the odds of subsequent total knee replacement.

Jui-Ching Wu

(Ph.D, University of California,USA)

National Taiwan University

Tracking molecular dynamics during spermatocyte divisions in the nematode Caenorhabditis elegans

Spermatocytes exhibit a distinct type of cell division during which the duplicated genome undergoes two consecutive separations without pausing. Such repetition requires rearrangement of the division machineries in between the two separation events. Nonetheless, the mechanistic regulation underlining spermatocyte divisions has been poorly explored. Using the nematode Caenorhabditis elegans as a model, we tracked the dynamics of division-specific molecules during spermatocyte divisions. In combination with inhibitor treatments, we found the two division events might subject to distinct regulatory mechanisms.

Kung-Bin Sung

(Ph.D, University of Texas at Austin,USA)
National Taiwan University

Toward quantitative dosage analysis of transcranial photobiomodulation with red to near-infrared light

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Transcranial photobiomodulation (tPBM) has been increasingly used to produce neuroprotective and neuroenhancing effects of the brain non-invasively using red to near-infrared light. Quantitative analysis of the optimal dosage, however, has not been sufficiently performed mainly due to the lack of knowledge about the fraction of the applied photon energy that penetrates to the targeted cerebral regions. To facilitate both further research on the mechanism and practical uses of tPBM, we aim to develop enabling techniques to quantify photon energy delivery to the gray matter. Preliminary simulation analyses revealed up to one order of magnitude variations in the delivery efficiency due to large variations in both optical properties reported in the literature and anatomical structures among human subjects. Strategies to address the issues are discussed and the quantification of optical properties of major tissues in the human head in vivo is demonstrated.

Chia-Lung Hsieh

(Ph.D, California Institute of Technology,USA)
Academia Sinica

High-speed dynamic cell imaging by scattering-based interference optical microscopy

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Label-free optical microscopy provides the opportunity to observe biological cells in their native forms, but the imaging sensitivity, spatiotemporal resolution, and molecular specificity are usually compromised especially compared to the fluorescence-based approaches. In this talk, I will present a scattering-based interference optical microscope technique that overcomes the challenges aforementioned. Specifically, highly sensitive wide-field imaging is achieved by interferometric detection and contrast enhancement via back-pupil engineering. Exploiting the stable scattering signal, ultrahigh-speed imaging at 100,000 frames per second was realized by using a high-speed CMOS camera. The adverse effects of nonspecific background scattering and speckles were suppressed by image post-processing, and therefore high spatial resolution and imaging specificity can be accomplished. I will show a few applications of the high-speed label-free dynamic cell imaging, e.g., the single virus diffusion on the cell membrane, 3D transportation of cell vesicles, and the cell nucleus dynamics.

Szu-Yu Chen

(Ph.D, National Taiwan University)
National Central University

Study of violin spruce woods with aid of two-photon hyperspectral imaging

Violin-family instruments commonly use spruce as tonewood for the top plate. The acoustic quality is critically affected by the wood properties which have been shown different between modern and old ones due to chemical treatment and aging. In this research, a two-photon hyperspectral system was introduced to reveal the microscopic differences within spruce wood samples in both spatial and spectral domains. Via the variations of autofluorescence spectrum and second harmonic generation intensity, the evidences of chemical treatments and aging in old wood samples have been shown.

Shi-Wei Chu

(Ph.D, National Taiwan University)
National Taiwan University

High-speed volumetric imaging for brain

Since the days of Cajal, optical microscopy has been a vital tool for physiology, and neuroscientists have accumulated significant amount of information on structures and functions of isolated neurons. However, to understand the emergent properties of a brain, functional observation of complicated neuronal networks is necessary, leading to the request of volumetric imaging with high speed, deep penetration, and sub-cellular resolution. In this talk, I report our recent advances on pushing the speed of volumetric imaging, and its applications on Drosophila and mouse brains.

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