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COCHE HKSTP

The 14th IEEE International Summer School and Symposium on Medical Devices and Biosensors in conjunction with The 12th International School and Symposium on Biomedical and Health Engineering and The 1st International Summit on Cerebro-Cardiovascular Health Engineering (MDBS-CHE’ 2021)

Sponsored by: IEEE Engineering in Medicine & Biology Society (EMBS)
Organized by: Hong Kong Centre for Cerebro-Cardiovascular Health Engineering (COCHE)
Co-organized by: Hong Kong Science and Technology Parks Corporation (HKSTP)

18-20 Nov 2021

https://www.mdbs-che2021.org/

About MDBS-CHE’ 2021

The 14th IEEE International Summer School and Symposium on Medical Devices and Biosensors (MDBS) will be held in hybrid mode on 18-20 November 2021 in conjunction with the 12th International School and Symposium on Biomedical and Health Engineering and the 1st International Summit on Cerebro-Cardiovascular Health Engineering (CHE). The first day of MDBS-CHE’ 2021 will be held both virtually via zoom and physically on-site at **INNO^2, 2/F, Building 17W, 17 Science Park West Avenue, Hong Kong Science Park, Hong Kong SAR, China on 18 November 2021** while the rest two days of the joint event from 19-20 November will be conducted virtually **via Zoom**.

The distinguished scientists and faculty members from the world leading universities in different countries are invited to give speeches and present state-of-the-art technologies in the areas of biomedical and health engineering especially biosensors and wearable medical devices, medical imaging, robotics and AI with applications in the prediction and control of cardiovascular diseases (CVD) and coronavirus diseases (COVID). The main theme of MDBS-CHE’ 2021 is “**Health Engineering for the Precise Control of CVD and COVID**”.

MDBS-CHE’ 2021 Main Topics include

- **Flexible, wearable and implantable sensors and devices**
- **Multi-modal biomedical imaging**
- **AI in biomedical and health engineering**
- **Bio-inspired robotics, biomimics, and drug delivery devices**
- **Flexible, stretchable and printable bioelectronics**
- **Body sensor networks (BSN)/Body area networks (BAN)/body net**
- **Unobtrusive physiological sensing**
- **Nano-sensing and nano-technologies for bio-marker detection**
- **Multi-scale modeling and information fusion**
- **Applications in cardiovascular, stroke, neurological and other major diseases**
- **Application in Coronavirus disease 2019 (COVID-19)**
- **Health Engineering and informatics for precision medicine**

Organizing Committee

Conference Chair: Yuan-ting Zhang / Hong Kong Centre for Cerebro-Cardiovascular Health Engineering
Conference Co-Chair: Paolo Bonato / Harvard Medical School
Conference Co-Chair: David Clifton / University of Oxford
Organizing Committee Chair: Carrie Ling / Hong Kong Science and Technology Parks Corporation

HKSTP

Chair

Yuan-ting Zhang

Co-Chairs

Paolo Bonato

David Clifton

OC Chair

Carrie Ling

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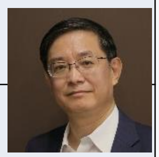
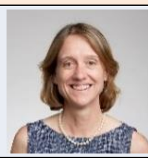
Programme Overview

Lectures available on zoom & HKSTP

Hong Kong Time	US Central Time	Europe Time London	Activities
Nov 18 Thursday (physically on-site and virtually by Zoom)			
09:00	19:00 (Nov 17)	01:00	Registration on-site
09:30-09:35	19:30-19:35 (Nov 17)	01:30-01:35	**Opening Speech by Metin AKAY** FIEEE, FIAMBE, FAAAS, President of IEEE EMBS Founding Ch and John S Dunn Endowed Chair Professor University of Houston   
09:35-09:40	19:35-19:40 (Nov 17)	01:35-01:40	**Opening Speech by Albert WONG** Chief Executive Officer of HKSTP
09:40-09:45	19:40-19:45 (Nov 17)	01:40-01:45	**Opening Speech by Yuanting ZHANG** FIAMBE, FIEEE, FAIMBE, MSigmaXi Chair for MDBS-CHE' 2021 Chairman and Director of COCHE, City University of Hong Kong
09:45-10:20	19:45-20:20 (Nov 17)	01:45-02:20	**COCHE Distinguished Lecture &** **Keynote 1: Zhi-Pei LIANG** FIEEE, FAIMBE, Chair-elect of IAMBE, Former President of IEEE-EMBS University of Illinois at Urbana-Champaign **"Molecular Imaging with Spins: A Marriage of Quantum Mechanics with Machine Learning to Achieve High Resolution"** *Moderator: Yuanting ZHANG* 
10:20-10:35	20:20-20:35 (Nov 17)	02:20-02:35	Tea Break/Registration
10:35-11:10	20:35-21:10 (Nov 17)	02:35-03:10	**Keynote 2: Andrew LAINE** FIAMBE, FIEEE, Former President of IEEE-EMBS Columbia University **"Data Harmonization: An Imaging-driven omics database / repository on COVID survivors"** *Moderator: Kannie CHAN*  
11:10-11:45	21:10-21:45 (Nov 17)	03:10-03:45	**Keynote 3: Dinggang SHEN** FIEEE, FAIMBE, Dean of BME, Shanghai Tech University **"AI based Medical Image Reconstruction"** *Moderator: Kannie CHAN*
11:45-13:00	21:45-23:00 (Nov 17)	03:45-05:00	Lunch Break
13:00-14:00	23:00-00:00	05:00-06:00	COCHE Centre Tour in 19W & 17W (Leaving from Conference Room in Inno² at 13:00)
14:00-14:35	00:00-00:35	06:00-06:35	**Keynote 4: Qingming LUO** FAIMBE, CAS Academician, President of Hainan University **"Visualizing Brain-wide Networks at Single-Neuron Resolution with Micro-Optical Sectioning Tomography"** *Moderator: Jian LU*  
14:35-15:10	00:35-01:10	06:35-07:10	**Keynote 5: Jian LU** FHKAES, Academician, National Academy Technologies of France, City University of Hong Kong **"Nanostructured materials and 3D/4D printing for biomedical applications"** *Moderator: Bee Luan KHOO*
15:10-15:25	01:10-01:25	07:10-07:25	Break/Registration
15:25-16:00	01:25-02:00	07:25-08:00	**Keynote 6: SUN Dong** FCAE, FIEEE, Chair of BME City University of Hong Kong **"Toward Microrobot Delivery for Targeted Therapy"** *Moderator: Jian LU*  
16:00-16:35	02:00-02:35	08:00-08:35	**Keynote 7: Shih-chi CHEN** Member of ASME, ASPE Chinese University of Hong Kong **"Recent advances in two-photon microscopy for studying cardiovascular diseases"** *Moderator: Chunyi ZHI, Professor, City University of Hong Kong*
16:35-17:10	02:35-03:10	08:35-09:10	**Keynote 8: Kannie CHAN** Associate Director of COCHE City University of Hong Kong **"MR imaging of molecules and vasculature in the brain"** *Moderator: Bernard CHU, Associate Professor, City University of Hong Kong*  
17:10-17:40	03:10-03:40	09:10-09:40	**Keynote 9: Renjie ZHOU** Assistant Professor Chinese University of Hong Kong **"Single-frame Label-free Cell Tomography for High Throughput 3D Image Cytometry Applications"** *Moderator: Zhao Ni, Professor & Department Vice-Chair (Graduate), Chinese University of Hong Kong*
17:40-18:00	03:40-04:00	09:40-10:00	Group photo shooting
18:00-18:30	04:00-04:30	10:00-10:30	Drinks and break
18:30-20:00	04:30–06:00	10:30-12:00	COCHE Annual Dinner and Conference Buffet (Lucky Draw and OS-CARE Award Ceremony)
20:00-20:35	06:00-06:35	12:00-12:35	**COCHE Distinguished Lecture &** **Keynote 10: Alison NOBLE** FRS, FREng University of Oxford Co-Director of COCHE **"Simplifying ultrasound – progress and the opportunities in fetal echocardiography"** *Moderator: Raymond CHAN, VP(SA), City University of Hong Kong, Co-Director of COCHE* 

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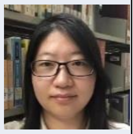
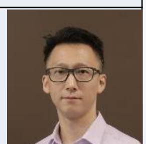
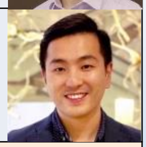
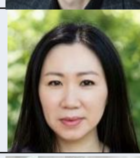
Nov 19 Friday (by Zoom)			
09:30-10:05	19:30-20:05 (Nov 18)	01:30-02:05	**Keynote 11:** **DEEN Jamal** FIEEE, FRSC, FCAE, McMaster University **TAPAS Mondal** Associate Professor, McMaster University **"Wearable Sensors and Systems with CVD Applications"** *Moderator: Derek HO, Associate Professor, City University of Hong Kong*  
10:05-10:40	20:05-20:40 (Nov 18)	02:05-02:40	**Keynote 12: Xinge YU** Innovator under 35 by the MIT Technology Review City University of Hong Kong **"Skin-integrated electronics for VR/AR"** *Moderator: Bee Luan KHOO* 
10:40-11:10	20:40-21:10 (Nov 18)	02:40-03:10	**Young Scientist Session 1: Flexible Sensing** **Binbin ZHANG** Postdoctoral Fellow, COCHE **Ya HUANG** Postdoctoral Fellow, COCHE *Moderator: Xinge YU*  
11:10-11:45	21:10-21:45 (Nov 18)	03:10-03:45	**Keynote 13: Bee Luan KHOO** Innovator under 35 by the MIT Technology Review City University of Hong Kong **"Microfluidic tools for disease detection"** *Moderator: Xinge YU* 
11:45-14:25	21:45-00:25	03:45-06:25	**Break**
14:25-14:55	00:25-00:55	06:25-06:55	**Young Scientist Session 2: Biomolecular Detection** **Richard YANDO** Postdoctoral Fellow, COCHE **Xi ZHAO** PhD Student City University of Hong Kong *Moderator: SHI Peng*  
14:55-15:25	00:55-01:25	06:55-07:25	**Keynote 14: SHI Peng** Professor, City University of Hong Kong **"Spatial-temporal epigenetic profiling based on high-throughput single cell Intracellular biopsy"** *Moderator: Xinge YU* 
15:25-15:55	01:25-01:55	07:25-07:55	**Invited Talk: Jacque IP** Honary Fellow of COCHE, Assistant Professor, Chinese University of Hong Kong **"Multidisciplinary Approaches to Investigate Cognitive Impairment in CVD"** *Moderator: Xinge YU* 
15:55-16:30	01:55-02:30	07:55-08:30	**Break**
16:30-17:05	02:30-03:05	08:30-09:05	**Keynote 15: David CLIFTON** Research Fellow of RAE, OCC Fellow in AI & ML University of Oxford, Associate Director of COCHE **"ML for Pandemics"** *Moderator: Raymond CHAN, VP(SA), City University of Hong Kong, Co-Director of COCHE* 
17:05-17:40	03:05-03:40	09:05-09:40	**Keynote 16: Tingting ZHU** RAE Fellow, University of Oxford **"AI for Time-series Patient monitoring and Risk Prediction"** *Moderator: Raymond CHAN, VP(SA), City University of Hong Kong, Co-Director of COCHE* 
17:40-18:15	03:40-04:15	09:40-10:15	**Keynote 17: Yihai CAO** Foreign Academician of CAE Professor of Vascular Biology, Karolinska Institutet **"Targeting angiogenesis for disease therapy: Approaching clinical issues of cardiovascular disease"** *Moderator: SHI Peng* 

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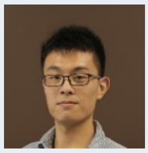
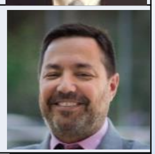
Nov 20 Saturday (by Zoom)			
09:30-10:05	19:30-20:05 (Nov 19)	01:30-02:05	**Keynote 18: Xiaochuan PAN** FIAMBE, FAIMBE, FIEEE EIC of T-BME University of Chicago **"Imaging-Based Intraoperative Assessment of Specimen Tumor Margin in Breast Conserving Surgery"** *Moderator: May WANG, Professor, Georgia Institute of Technology* 
10:05-10:40	20:05-20:40 (Nov 19)	02:05-02:40	**Keynote 19: Nigel LOVELL** FAIMBE, FIAMBE, FIEEE Former President of IEEE-EMBS UNSW **"Biomedical Engineering Advances in COVID-19 Times"** *Moderator: May WANG, Professor, Georgia Institute of Technology* 
10:40-11:25	20:40-21:25 (Nov 19)	02:40-03:25	**Young Scientist Session 3: Microscopy & Fluorescent** **Gan LIU** PhD Student City University of Hong Kong **XinRui WANG** PhD Student City University of Hong Kong **Qiuyuan ZHONG** Postdoctoral Fellow, COCHE *Moderator: Shih-chi CHEN*   
11:25-12:10	21:25-22:10 (Nov 19)	03:25-04:10	**Young Scientist Session 4: Biosensor** **Zhiqiang MA** Postdoctoral Fellow, COCHE **Shangjie ZOU** PhD Student City University of Hong Kong **Tianfu ZHANG** Postdoctoral Fellow, COCHE *Moderator: Bee Luan KHOO*   
12:10-19:55	22:10-05:55	04:10-11:55	**Break**
19:55-20:30	05:55-06:30	11:55-12:30	**Keynote 20: Dimitris FOTIADIS** FIAMBE, FIEEE, EIC of JBHI, University of Ioannina **"In Silico Clinical Trials: the BVS paradigm"** *Moderator: John FANG, Chair of BME, Shantou University* 
20:30-21:05	06:30-07:05	12:30-13:05	**Keynote 21: BONATO Paolo** EIC of OJEMB Harvard Medical School **"Using Mobile Health Technology to Inform the Clinical Management of Patients with Neurological Conditions"** *Moderator: John FANG, Chair of BME, Shantou University* 
21:05-21:15	07:05-07:15	13:05-13:15	**Closing Remark by David CLIFTON** Co-Chair for MDBS-CHE' 2021 *Moderator: John FANG, Chair of BME, Shantou University* 
End			

Zhi-Pei Liang

Franklin W. Woeltge Professor, ECE Department
Co-chair, Integrative Imaging Theme,
FIEEE, Former President of IEEE-EMBS,
Beckman Institute University of Illinois at Urbana-Champaign, USA
Email: z-liang@illinois.edu

Prof. Zhi-Pei Liang received his Ph.D. degree in Biomedical Engineering from Case Western Reserve University in 1989. He subsequently joined the University of Illinois at Urbana-Champaign (UIUC) first as a postdoctoral fellow (supervised by the late Nobel Laureate Paul Lauterbur) and then as a faculty member in the Department of Electrical and Computer Engineering. Dr. Liang is currently the Franklin W. Woeltge Professor of Electrical and Computer Engineering; he also co-chairs the Integrative Imaging Theme in the Beckman Institute for Advanced Science and Technology. Dr. Liang's research is in the general area of magnetic resonance imaging and spectroscopy, ranging from spin physics, signal processing, machine learning, to biomedical applications. Research from his group has received a number of recognitions, including the Sylvia Sorkin Greenfield Award (Medical Physics, 1990), Whitaker Biomedical Engineering Research Award (1991), NSF CAREER Award (1995), Henry Magnuski Scholar Award (UIUC, 1999), University Scholar Award (UIUC, 2001), Isidor I. Rabi Award (International Society of Magnetic Resonance in Medicine, 2009), IEEE-EMBC Best Paper Awards (2010, 2011), IEEE-ISBI Best Paper Award (2010, 2015), Otto Schmitt Award (International Federation for Medical and Biological Engineering, 2012), Technical Achievement Award (IEEE Engineering in Medicine and Biology Society, 2014), and Andrew Yang Research Award (UIUC, 2017). Dr. Liang was selected as the Paul C. Lauterbur Lecturer for the 2016 ISMRM meeting and as the Savio L. Woo Distinguished Lecturer for the 2017 WACBE World Congress on Bioengineering. He is a Fellow of the IEEE, the International Society for Magnetic Resonance in Medicine, the American Institute for Medical and Biological Engineering, and the International Academy of Medical and Biological Engineering. Dr. Liang served as President of the IEEE Engineering in Medicine and Biology Society from 2011-2012 and received its Distinguished Service Award in 2015. He was elected Chair-elect of the International Academy of Medical and Biological Engineering in 2021.

Molecular Imaging with Spins: A Marriage of Quantum Mechanics with Machine Learning to Achieve High Resolution

Since its invention in the early 1970s, magnetic resonance imaging (MRI) has become a premier tool for structural imaging and functional imaging using water proton spin signals. MR spectroscopic imaging (MRSI) has also long been recognized as a potentially powerful tool for noninvasive molecular imaging by exploiting the spin signals from other molecules. However, state-of-the-art MRSI methods, after more than four decades of development, still far short of providing adequate spatial resolution, speed, and signal-to-noise ratio useful for routine clinical applications.

The talk will discuss our recent "breakthroughs" in overcoming the longstanding technical barriers of MRSI-based molecular imaging using a new technology known as SPICE (SPectroscopic Imaging by exploiting spatiospectral CorrElation). SPICE uses a subspace mathematical framework to effectively integrate rapid scanning, sparse sampling, constrained image reconstruction, quantum simulation, and machine learning. Preliminary results show an unprecedented capability for simultaneous mapping of brain structures, function and metabolism using intrinsic spin signals from multiple molecules. In this talk, I'll give an overview of SPICE and also show some "SPICY" experimental results we have obtained.

Andrew Laine

FIAMBE, FIEEE, Former President of IEEE-EMBS
Professor of Radiology (Physics)
Department of Biomedical Engineering, Columbia University, USA
Email: al418@columbia.edu

Andrew F. Laine received his D.Sc. degree from Washington University (St. Louis) School of Engineering and Applied Science in Computer Science, in 1989 and BS degree from Cornell University (Ithaca, NY). He was a Professor in the Department of Computer and Information Sciences and Engineering at the University of Florida (Gainesville, FL) from 1990-1997. He joined Columbia University in 1997 and served as Vice Chair of the Department of Biomedical Engineering 2003 – 2011, and Chaired of the Department of Biomedical Engineering 2012 – 2017. He is currently the Percy K. and Vida L. W. Hudson Professor of Biomedical Engineering and Professor of Radiology (Physics).

His contributions and impact of research includes being among the first to use multiscale wavelet representations to enhance subtle details in mammograms and improve the detection of breast cancer. Today, the multi-scale algorithm he developed is used in almost all commercial digital mammography systems. His more recent / current research focuses on image analysis to classify pulmonary emphysema subtypes (COPD) in lung images and cardiac disease with the aim to identifying pathways of disease processes amenable to intervention and cure. He is also collaborating on research projects on applications of dual energy lung CT including generating virtual contrast images from non-contrast CT using deep learning techniques.

Professor Laine served on the IEEE ISBI (International Symposium on Biomedical Imaging) steering committee, 2006-2009 and 2009 – 2012. He was the Program Chair for the IEEE EMBS (Engineering in Biology and Medicine Society) annual conference in 2006 held in New York City and served as Program Co-Chair for IEEE ISBI in 2008 (Paris, France). He served as Area Editor for IEEE Reviews in BME in Biomedical Imaging since 2007-2013. He was Program Chair for the EMBS annual conference for 2011 (Boston, MA). Professor Laine Chaired the Steering committee for IEEE ISBI, 2011-2013, and Chaired the Council of Societies for AIMBE (American Institute for Medical and Biological Engineers) in 2012-2013. Finally, he served as IEEE EMBS Vice President of Publications 2008 – 2012, and was the President of IEEE EMBS 2015 and 2016. He is currently past-chair of the IEEE EMBS Technical Committee on Biomedical Health Informatics. He is a Fellow of IEEE, AIMBE and IFMBE.

Data Harmonization: An Imaging-driven omics database / repository on COVID survivors for retrospective understanding of COVID disease and planning for future care.

Consistent imaging protocols will require normalization / harmonization of data sourced from multiple platforms, hospitals and vendors. AI has shown a remarkable ability to generalize and group / tease out patterns from high-dimensional data. Machine / deep learning algorithms should rely on mix-omics integration of imaging and physiological measures. There is an urgent need for new models of multi-modal transfer learning (e.g., understanding lung and heart functional interactions), and incremental learning as cohorts grow at an ever-faster face, combining data from states/countries.

We plan that imaging harmonization methods be applied on all discharged COVID patient imaging data. This phenotyping could lead to a better retrospective understanding of COVID disease pathways and prepare for future management of COVID-derived chronic pathologies. In addition, there are significant new chronic pathologies expected in COVID survivors (cardiomyopathy, pulmonary aspergillosis, hemoglobin / iron deficiencies) in the longer term, which will be challenging to treat and / or recognize. The harmonized baseline data during acute phase (US/CXR) and at discharge time (CT/CMR) would help tremendously in our ability to understand the implications of these pathologies.

The proposed harmonization platform would include normalization across vendors, sites, possible variations in protocols and patient size. We describe AI based harmonization methods to leverage a large number of baseline scans from existing and ongoing studies for density measures, texture and later airway topology. During this initial phase, the Columbia cohort would harmonize 2,500 subjects in total, sampling in proportion five distinct cohorts. In the long term we aspire to develop data sharing tools, with possible partnerships for long term / global infrastructure and computing, integrate expertise in multiple imaging modalities, lead an open AI approach to model, predict and understand stages of COVID-19.

Dinggang Shen

IEEE Fellow, AIMBE Fellow, IAPR Fellow and MICCAI Fellow
School of BME, FIEEE, FAIMBE, Shanghai Tech University, China
Shanghai United Imaging Intelligence Co., Ltd.
Email: dgshen@shanghaitech.edu.cn

Dinggang Shen is Professor and Founding Dean of School of Biomedical Engineering, Shanghai Tech University, and also Co-CEO of United Imaging Intelligence (UII). He is Fellow of IEEE, Fellow of The American Institute for Medical and Biological Engineering (AIMBE), Fellow of The International Association for Pattern Recognition (IAPR), and also Fellow of The Medical Image Computing and Computer Assisted Intervention (MICCAI) Society. He was Jeffrey Houpt Distinguished Investigator, and (Tenured) Full Professor in the University of North Carolina at Chapel Hill (UNC-CH), directing The Center of Image Analysis and Informatics, The Image Display, Enhancement, and Analysis (IDEA) Lab, and The Medical Image Analysis Core. He was also a tenure-track Assistant Professor in the University of Pennsylvanian (UPenn) and a faculty member in the Johns Hopkins University. His research interests include medical image analysis, computer vision, and pattern recognition. He has published more than 1100 peer-reviewed papers in the international journals and conference proceedings, with H-index 115 and >50K citations. He serves as Editor-in-Chief for *Frontiers in Radiology*, as well as editorial board member for eight international journals. Also, he has served in the Board of Directors, The Medical Image Computing and Computer Assisted Intervention (MICCAI) Society, in 2012-2015, and was General Chair for MICCAI 2019.

AI based Medical Image Reconstruction

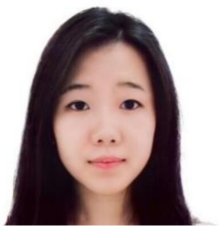
This talk will introduce various deep learning methods we developed for fast MR acquisition, low-dose CT reconstruction, and low-cost and low-dose PET acquisition. The implementation of these techniques in scanners for real clinical applications will be demonstrated. Also, comparisons with state-of-the-art acquisition methods will be discussed.

OS-CARE Award Finalists

** in alphabetical order

Group 1

Dr JI Nan



Ms XIANG Ting

Group 2

Dr MA Ziqiang

Group 3

Dr PAN Fei

Group 4

Dr WANG Donghong

Dr YANG Qi

Group 5

Dr ZHANG Tianfu

Qingming Luo

CAS Academician, President of HNU, School of Biomedical Engineering, Hainan University, China
Email: qluo@hainu.edu.cn

Dr. Luo’s research interests focus on multi-scale optical bioimaging and cross-level information integration. He forged a new discipline Brainsmatics. His team created “the most detailed three-dimensional map of all the connections between the neurons in a complete mouse brain” and “demonstrated the first long-range tracing of individual axons in the mouse brain” with their home-made Brain-wide Positioning Systems (BPS). He is an elected Member of Chinese Academy of Sciences (CAS), Chinese Academy of Medical Sciences (CAMS), elected Fellow of The International Academy of Medical and Biological Engineering (IAMBE), The American Institute for Medical and Biological Engineering (AIMBE), The International Society for Optics and Photonics (SPIE), The Institution of Engineering and Technology (IET), The Optical Society (OSA) and Chinese Optical Society (COS). With his leading contributions, the Biomedical Engineering in HUST was rated A+ in the latest 4th round of China Discipline Ranking. Dr. Luo is the elected Chair of Biomedical Engineering Steering Committee for Guidance in Teaching in Higher Educations Institutions 2018-2022 appointed by MoE.

Visualizing Brain-wide Networks at Single-Neuron Resolution with Micro-Optical Sectioning Tomography

The brain is the most complex and significant organ, but little is known regarding to the mechanisms of its function, which is related to brain anatomy. Conventional anatomical methods based on brain slices fail to reconstruct the neural projection in axial direction at single-cell resolution. To solve the problem, my lab has spent more than ten years developing Brain-wide Positioning System (BPS), a novel solution combining microscopic optical imaging and physical sectioning to obtain the tomographic information of a whole brain with sub-micron voxel resolution. BPS includes several generations such as Micro-Optical Sectioning Tomography (MOST) and several types of fluorescence MOST (fMOST). In this talk, I will introduce the principles of BPS and demonstrate how to locate and visualize the labelled neurons and neuronal networks in the whole brain. The pipeline includes whole-brain sample preparation, whole-brain optical imaging, and massive brain image processing and analyzation. BPS may play a crucial role and usher in a new era of Brainsmatics. Brainsmatics refers to the integrated, systematic approaches of measuring, analyzing, managing, and displaying brain spatial data, including but not limited to the concepts of digital mapping and visualization of the brain neuronal/vascular networks, brain atlas, brain connectome and projectome, brainnetome, neuroinformatics, and neuroimaging. Brainsmatics will provide comprehensive and systematic information to understand the brain, defeat the brain disease, and develop the brain-inspired intelligence.

Jian Lu

FHKAES, Academician, National Academy Technologies of France,
City University of Hong Kong, Hong Kong SAR, China
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Prof. Jian LU is Chair Professor of Mechanical Engineering; Vice-President (Research & Technology) and Dean of graduate study at the City University of Hong Kong (CityU). He obtained the Dip. Ing., Master (DEA) degree and Doctoral degree from University of Technology of Compiegne in 1984 and 1986 respectively. From 1986 to 1994, he was appointed as Senior Research Engineer at the CETIM (French Technical Centre for Mechanical Industry). In 1994, he was appointed as Professor; Head of Department of Mechanical Systems Engineering and Director of Mechanical Systems and Concurrent Engineering Laboratory jointly supported by the French Ministry of Education and CNRS at the University of Technology of Troyes, France. From 2005 to 2010, he was Chair Professor and Head of Department of Mechanical Engineering at the Hong Kong Polytechnic University. From 2010 to 2013, he was the Dean of College of Science and Engineering at CityU. From 2013 till now, he serves as the Vice-President (Research & Technology) and Dean of Graduate Studies of CityU.

Professor LU's primary research interest is advanced materials and its integration in mechanical and biomedical systems using the combination of experimental mechanics and mechanical simulation. He has also branched out into several other areas of interest including surface engineering, biomechanics, residual stresses, and mechanics of nanomaterials. He has published more than 350 SCI journal papers including papers in Nature (cover story), Science, Nature Materials, Nature Communications, Materials Today, Advanced Materials, PRL, Acta Materialia, and Journal of the Mechanics and Physics of Solids. He received the French Knight of the National Order of Merit and French Knight of the National Order of Légion d'Honneur in 2006 & 2017 respectively. Both awards were nominated by the President of the Republic of France and awarded by the French Government. He was elected as the 1st Chinese-born French Fellow by the National Academy of Technologies of France among 300 Fellows in 2011.

Nanostructured materials and 3D/4D printing for biomedical applications

Dong Sun

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Prof Dong Sun is the Chair Professor of Biomedical Engineering and Director of the Robotics and Automation Center at City University of Hong Kong (CityU). He graduated from Tsinghua University in Beijing and the Chinese University of Hong Kong, and then joined the University of Toronto, Canada. He has joined CityU since 2000. Professor Sun is a pioneer in applying microrobot technology to biomedicine. He was elected as Fellow of the Canadian Academy of Engineering, Member of European Academy of Sciences and Arts, and Fellow of IEEE. He has won many awards including China's Top Ten Technology Development Awards for Intelligent Manufacturing, China's Higher Education Natural Science Award, and Hong Kong Awards for Industry.

Toward Microrobot Delivery for Targeted Therapy

Using magnetically powered microrobots as carriers to deliver cells or drugs precisely is a promising technology in precision medicine. This talk will introduce our recent development of using magnet-driven microrobots to deliver therapeutic cells to lesions for targeted therapy. The invention will permit many new unforeseen clinical applications previously thought impossible, and profoundly affect therapeutic treatment in the future.

Shih-chi Chen

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Dr. Shih-Chi Chen is a Professor in the Department of Mechanical and Automation Engineering at the Chinese University of Hong Kong. He received his B.S. degree in Mechanical Engineering from the National Tsing Hua University, Taiwan, in 1999; and his S.M. and Ph.D. degrees in Mechanical Engineering from the Massachusetts Institute of Technology, Cambridge, in 2003 and 2007, respectively. Following his graduate work, he entered a post-doctoral fellowship in the Wellman Center for Photomedicine, Harvard Medical School, where his research focused on biomedical optics and endomicroscopy. From 2009 to 2011, he was a Senior Scientist at Nano Terra, Inc., a start-up company founded by Prof. George Whitesides at Harvard University, to develop precision instruments for novel nanofabrication processes. His current research interests include ultrafast laser applications, biomedical optics, precision engineering, and nanomanufacturing. Dr. Chen is a member of the American Society for Precision Engineering (ASPE), American Society of Mechanical Engineers (ASME), SPIE, and the Optical Society (OSA); and currently serves as the Associate Editor of ASME Journal of Micro- and Nano-Manufacturing, IEEE Transactions on Nanotechnology, and HKIE Transactions. In 2003 and 2018, he received the prestigious R&D 100 Awards for developing a six-axis nanopositioner and an ultrafast nanoscale 3-D printer respectively.

Recent advances in two-photon microscopy for studying cardiovascular diseases

Two-photon excitation (TPE) microscopy has become an important branch in fluorescent microscopy to study high-speed biological events in vivo with high penetration depth, i.e., 600 – 800 microns; although this is still considered "shallow" in many people's view for studying cardiovascular diseases (CVDs), it can be readily applied to investigate CVDs on various animal models with unique capabilities, e.g., real-time 3D imaging with subcellular resolution and molecular specificity etc., which cannot be found in conventional medical imaging systems, e.g., magnetic resonance imaging. In this seminar, I will first review the basic principle of TPE microscopy and its recent applications in studying CVDs; next, I will present our recent work on TPE microscopy, including the development of the first digital-micromirror device (DMD)-TPE microscope system based on binary holography which enables multi-focus random-access scanning at 22.7 kHz as well as the implementation of the sensorless adaptive optics algorithm to our DMD system for realizing deep brain imaging. Lastly, I will present the development of a two-photon tomography system, consisting of a TPE microscope and a custom-designed high-precision vibrating microtome, which can generate volumetric image of an entire organ, such as a mouse brain, heart or liver, with subcellular resolution.

Kannie Chan

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Dr. Chan's research focuses on the development of biomaterials and imaging approaches to facilitate the clinical translation of cancer therapy and cell therapy, and early diagnosis of neurodegenerative diseases. She received her BSc and PhD degrees from The University of Hong Kong. She completed post-doctoral fellowships in magnetic resonance imaging (MRI) at Department of Radiology, Johns Hopkins University School of Medicine, and became an Assistant Professor in 2014. She joined City University of Hong Kong in 2016. She is a leading researcher in applying a frontier molecular MRI contrast mechanism to address clinical needs, which is known as chemical exchange saturation transfer (CEST). She has pioneered the imaging of glucose utilization in the brain using CEST-MRI. The way how our brain uses glucose could have implications on diagnosis and therapy in many neurological disorders, including Alzheimer's disease and stroke. Her team is developing various techniques to effectively image and deliver drugs/cells in the brain non-invasively. She published over 60 peer-reviewed articles, including a cover article in Nature Materials, Science Advances, Theranostics and Nature Communications. She is a corporate member of HKIE, an adjunct faculty of Johns Hopkins University School of Medicine, and an associate director of COCHE. She served as AMPC member of ISMRM and is now at the publication committee of ISMRM.

MR imaging of molecules and vasculature in the brain

Abnormal changes of molecules and vasculature in the brain have implications in diseases, such as Alzheimer's disease and stroke. A frontier MR molecular imaging approach, named Chemical Exchange Saturation Transfer (CEST), will be introduced and its related applications in early Alzheimer's disease detection will be discussed. Other molecular changes in the brain could indicate the cognitive health, such as myelin. Moreover, abnormality of cerebrovasculature, e.g. small vessel disease, which contributed to about 20% of stroke. By using advanced MRI, we could monitor these subtle changes in the brain non-invasively for better health management.

Renjie Zhou

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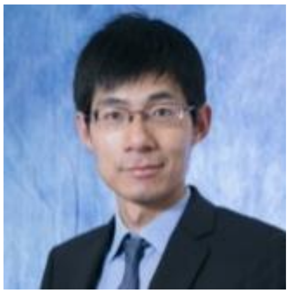

Dr. Renjie Zhou is an Assistant Professor in the Department of Biomedical Engineering at The Chinese University of Hong Kong. He directs the Laser Metrology and Biomedicine Laboratory which he founded in 2017. Dr. Zhou received his doctoral degree in Electrical and Computer Engineering from the University of Illinois at Urbana-Champaign in 2014 and undertook postdoctoral training at the George R. Harrison Spectroscopy Lab at MIT from 2014-2017. His current research interest is in developing optical precision instruments for material metrology and biomedical imaging applications. He has published over 40 journal papers and filed 5 US patent applications.

Single-frame Label-free Cell Tomography for High Throughput 3D Image Cytometry Applications

Quantitative phase imaging (QPI) is a label-free imaging technique that has been widely applied to biomedical imaging and material metrology. We have recently empowered QPI with artificial intelligence (AI) and high three-dimensional (3D) imaging speed to realize high-throughput single cell analysis with a high accuracy. For this endeavor, we developed SIngle-frame Label-free Cell Tomography (SILACT) that can achieve diffraction-limited spatial resolution and sub-millisecond temporal resolution. SILACT is realized through training a deep neural network (DNN) in an angle-multiplexed optical diffraction tomography (ODT) system to reconstruct the 3D refractive index maps of cells. Cells of various types are reconstructed in 3D using this method and the results are validated with a beam propagation-based reconstruction method. We applied this new imaging method for observing 3D red blood cell deformations in microfluidic channels and demonstrating 3D image flow cytometry at a throughput of over 10,000 cells/second. We will present these progresses and highlight their potential applications.

Alison Noble

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Alison Noble was an undergraduate and a postgraduate research student at St Hugh’s College, Oxford studying Engineering Science and Computer Vision respectively. She became a research scientist at the GE Corporate R&D Center, Schenectady NY USA following DPhil (PhD) graduation before appointment to the Oxford Engineering Science faculty in 1995. Alison Noble was elected a Professor of Engineering Science in 2002, and the Technikos Professor in Biomedical Engineering in 2011. Professor Alison Noble was the Director of the Institute of Biomedical Engineering from 2012-16 and an Associate Head of the Mathematical, Physical and Life Sciences Division at the University of Oxford, 2016-19.

Alison’s research interests are in ultrasound imaging, computational (machine-learning based) analysis of images, and the development of decision-support tools for medical professionals. Her research is motivated by clinical unmet needs in western and developing world healthcare settings. She co-founded Intelligent Ultrasound Ltd to commercial research from her laboratory which was acquired by MedaPhor Group Plc (now called Intelligent Ultrasound Group) in 2017.

Alison is a former president of the Medical Image Computing and Computer-Assisted Interventions (MICCAI) Society. She has served as a member and then Chair of the EPSRC Healthcare Technologies Strategic Advisory Team (2014-19) and a Trustee of the Institute of Engineering Technology (IET) 2016-19. She is a member of REF 2021 Subpanel 12 (Engineering). Professor Alison Noble is a Fellow of the Royal Academy and of the Royal Society, and a Trustee of the Oxford Trust. She received an OBE for services to science and engineering in the Queen's Birthday Honours list in June 2013.

Simplifying ultrasound – progress and the opportunities in fetal echocardiography

Deep learning has become a mainstream tool in medical image analysis over the last decade. This talk provides a brief overview of how it is impacting ultrasound image analysis, both in terms of traditional analysis task automation and suggesting new ways
to simplify ultrasound for end users. Simplifying ultrasound is key to broader application of ultrasound in new clinical settings and to address important unmet clinical needs. Fetal echocardiography provides one such example, and we conclude by highlighting some of
the unique challenges, and hence research opportunities, posed in this under-researched area.

Jamal Deen

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Jamal Deen is a Distinguished University Professor and Canada Research Chair in Information Technology, McMaster University. His research interests are nano-/opto-electronics, nanotechnology, data analytics and their applications to health and environmental sciences. His research record includes more than 645 peer-reviewed articles (~20% are invited), two textbooks, 6 awarded patents extensively used in industry, and 21 best paper/poster/ presentation awards. As an undergraduate, he was the top ranked mathematics and physics student and the second ranked student at the university, winning the Chancellor’s gold medal and the Irving Adler prize. As a graduate student, he was a Fulbright-Laspau Scholar and an American Vacuum Society Scholar. He is a Distinguished Lecturer of the IEEE (Institute of Electrical and Electronic Engineers) Electron Devices Society for more than 15 years. His awards and honours include the Callinan Award and the Electronics and Photonics Award from the Electrochemical Society (ECS); a Humboldt Research Award from the Humboldt Foundation; the Eadie Medal from the Royal Society of Canada (RSC); the McNaughton Gold Medal, Fessenden Medal and Ham Education Medal, all from IEEE Canada. He was also awarded four honorary doctorate degrees in recognition of his exceptional research and scholarly accomplishments, exemplary professionalism and valued services. He is elected by his peers to Fellow status in twelve national academies and professional societies including RSC, Chinese Academy of Sciences, IEEE, the Electrochemical Society, and the American Physical Society. Recently, he was appointed to the Order of Canada – the highest civilian honor in Canada. He served as the elected President of the Academy of Science, RSC from 2015 to 2017.

Tapas Mondal is a pediatric cardiologist at McMaster University since 2005. He is an Associate Professor of Pediatrics at McMaster University and an associate member in the Hospital for Sick Children, Toronto, also as an associate member in the faculty of Engineering at McMaster University. Dr. Mondal was honored with the Best Teacher award from McMaster University in 2009 (also nominated as Best teacher in 2006 and 2020) and received the Best Senior Resident honor from Kalawati Saran Children’s Hospital in Delhi, India. He was awarded Jeffrey Coates award in 2018 as the first Pediatrician recipient considered to be the best physician of the city of Hamilton. Dr. Mondal delivers integrated, personalized, family-centered patient care while creating an advanced learning environment for highly skilled personnel. His research interests center around different imaging techniques including low-cost health monitoring systems.

Wearable Sensors and Systems with CVD Applications

The significant advances we have witnessed in semiconductor technology in past several decades has driven remarkable innovations in information and communications systems that seemed to be science fiction in the late twentieth century. Now, more recently in the past couple of decades, advances in semiconductor technologies are driving innovations in low-cost, user-friendly smart wearable sensors and systems to manage health. This is especially important in the realm of remote, personalized patient care that is recently catalyzed by the COVID-19 pandemic. In the first part of this presentation, we will discuss the symptoms and diagnoses of common cardiovascular diseases (CVDs) such as arrhythmias and cardiomyopathy, and the gaps in our understanding from the clinical perspective. In the second part, we will discuss the important role of wearable sensors and systems in monitoring CVDs. We will introduce the key enabling technologies for sensors, low-power data processing and communications, and data analysis to create smart wearable sensors and systems used to manage health, with a focus on the heart and CVDs.

Xinge YU

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Dr Xinge Yu is currently an Assistant Professor of Biomedical Engineering at City University of Hong Kong (CityU). Xinge Yu got his bachelor degree from University of electronics Science and Technology of China (UESCT) in 2009 and conducted his Ph.D. research in printable flexible electronics at Northwestern University and received his Ph.D. degree in Optical Engineering from UESTC in 2015. From 2015 to 2018, Xinge Yu was a postdoctoral research associate at Northwestern University and University of Illinois at Urbana-Champaign, where he was working on flexible bio-electronics. Now Xinge Yu's research group is focusing on skin-integrated electronics and systems for biomedical applications. He has published over 100 papers in the top journals, such as Nature, Nature Materials, Nature Biomedical Engineering, Nature Communications, PNAS, Science Advances etc., and held 15 patents pending or granted. Dr Yu serves as an associate director of the CAS-CityU Joint Lab on Robotics, and an associate editor/editorial members for 5 journals. Dr Yu is also the recipient of Innovators under 35 China (MIT Technology Review), New Innovator of IEEE NanoMed, MINE Young Scientist Award.

Skin-integrated electronics for VR/AR

Technologies for virtual and augmented reality (VR and AR) create human experiences through visual and auditory stimuli that replicate sensations associated with the physical world. The most widespread VR/AR systems use head-mounted displays, accelerometers and speakers as the basis for three-dimensional, computer-generated environments that can exist in isolation or as overlays with actual scenery. By comparison to the eyes and the ears, the skin is a relatively underexplored sensory interface for VR/AR technology that could, nevertheless, greatly enhance experiences, at a qualitative level, with direct relevance in areas ranging from communications and social media, to gaming, entertainment and prosthetics technology. Here we present materials, device structures, power delivery strategies and communication schemes as the basis for a wireless, battery-free platform of electronic systems and haptic interfaces capable of softly laminating onto the skin to communicate information via spatio-temporally programmable patterns of localized mechanical vibrations. The resulting technology, which we refer as epidermal VR, creates many opportunities where the skin provides an electronically programmable communication and sensory input channel to the body, as demonstrated through example applications in social media/personal engagement, prosthetic control/feedback and gaming/entertainment.

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Water-evaporation-induced intermolecular force for nano-wrinkled polymeric membrane.

Ya Huang

Postdoctoral Fellow
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Wirelessly electrostimulation therapy system

Moderator: Xinge Yu

Bee Luan KHOO

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Dr. Khoo Bee Luan is a biomedical scientist focused on detecting, prognosis, and characterization of disease heterogeneity using multidisciplinary techniques. She joined the City University of Hong Kong in 2019. She is recognized for her efforts by the MIT Technology Review as an Innovator under 35 (Asia 2018) for her work on microfluidic devices with direct clinical relevance. Dr. Khoo's work includes the design and utilization of microfluidic devices for personalized cancer management and evaluation. She has also developed various microfluidic biochips for the direct isolation of primary cancer cells, diseased blood cells, or malaria-infected cells for rapid disease detection. Dr. Khoo has authored more than 30 articles in peer-reviewed journals and has presented in various invited international conferences. As a senior postdoctoral research fellow in the Singapore MIT alliance of Research and Technology, she was awarded the Young Investigator national grant award by the National Medical Research Council. Dr. Khoo recently received the Young Investigator award 2020 to support upcoming projects in disease detection via the Interstellar Initiative, funded by the Japan Agency for Medical Research and Development (AMED) and the New York Academy of Sciences.

Microfluidic tools for disease detection

The phenotype and genetic characteristics of rare disease cells in liquid biopsy can provide important disease detection and treatment information. Therefore, further research in this field is of great significance. We have established label-free microfluidic technologies based on inertial focusing with hydrodynamic forces in curved microchannels to isolate viable diseased cells based on size. This technology allows us to achieve a cell recovery rate of ≥85% and a white cell removal rate of 99.99% from whole blood in cancer applications. The technology has also been validated in other applications, including leukemia, malaria, and bladder cancer. This technology can be produced cost-effectively by standard micromachining and soft lithography (2-3 days) and is operated using a syringe pump. The fast-processing time (7.5 ml in 12.5 minutes for three-layer multiple devices) and the ability to collect and concentrate rare diseased cells from a large number of patients' liquid biopsies makes this technology suitable for a wide range of potential genome and transcriptome experiments to applications.

Richard Yando

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High throughput brain activity mapping and machine learning as a foundation for system neuropharmacology and cerebral blood flow

Ya Huang

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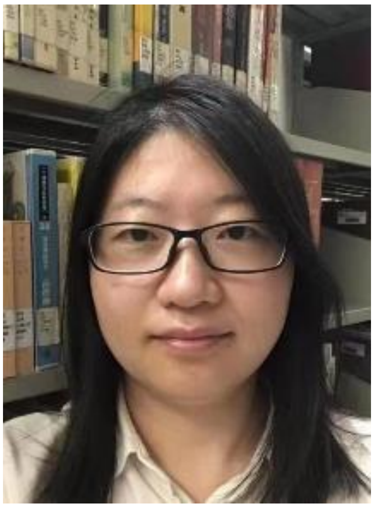
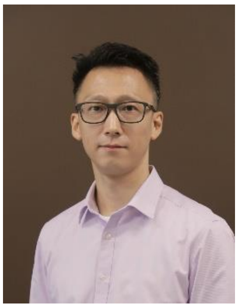


Molecular fishing based analysis of dual mRNA methylation with targeted gene specificity

Moderator: Peng Shi

Peng Shi



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Dr. Peng Shi is a professor in the Department of Biomedical Engineering at City University of Hong Kong. He received his bachelor’s degree in electrical engineering from Wuhan University and a Ph.D. degree in Biomedical Engineering from Columbia University. After his postdoctoral training at MIT in Electrical Engineering and Biological Engineering, he joined CityU Hong Kong and has been a faculty member in the BME department since 2011. Dr. Shi works at the convergence between neuroscience and engineering by taking advantage of an interdisciplinary approach that involves nano-/micro-fabrication, microfluidics, ultra-fast optics, high-resolution microscopy and imaging processing. He focuses on solving important emerging problems in translational neuro-engineering, especially in the development of high-throughput neuro-technology and screening platform for discovery of novel therapeutic targets. His work has led to more than 60 publications in top-tier research journals, including Nature BME, Science Advances, Nature communications etc., and 7 international patents and disclosures, one of which has been the foundation technology of a spin-off biotech company. Dr. Shi received the Simon’s research award in 2010, and was elected to the 1000 China Young Talent program. He also received the President Award for research excellence in 2017, outstanding supervisor award in 2018 at CityU, and a special recognition as Young Scholars by World Cultural Council in 2018. He is an associate editor for the journal Brain Research.

Spatial-temporal epigenetic profiling based on high-throughput single cell Intracellular biopsy

The capability to profile small RNAs responsible for post-transcriptional regulation of genes expression is essential for molecular identification and characterization of cellular phenotypes. However, compared to long RNA, the quantification of small RNA, such as microRNAs (miRNA), in live cells is still challenging. Also, miRNAs are suggested to play important roles in the pathogenesis and progress of human diseases with heterogenous regulation in different types of cells. However, limited technique is available for profiling miRNAs with both expression and spatial dynamics. Here, we describe an intracellular biopsy technique for fast, multiplexed and highly sensitive profiling of miRNAs. The technique employs an array of diamond nanoneedles that are functionalized with size-dependent RNA-binding-proteins, working as the “fishing rods” to directly pull multiple miRNA targets out of cytoplasm while keeping the cells alive. Each nanoneedle works as a separated reaction chamber for parallel in-situ amplification, visualization and quantification of miRNAs as low as femtomolar, which is sufficient to detect miRNAs of a single copy intracellular abundance and is also specific to single-nucleotide variation in closely-related miRNA sequences. The platform was further developed for multiplexed in situ miRNA profiling in acute tissue slices to achieve a quasi-single-cell analysis in a large population of mixed cells of a tissue sample. In addition to a quantitative evaluation of the expression level of particular miRNAs, the technique also provides the relative spatial dynamics of the cellular miRNAs in associated cell populations, which was demonstrated to be useful in analyzing the susceptibility and spatial reorganization of different types of cells in the tissues from normal or diseased animals. Using inCell-Biopsy, we analyze the temporal miRNA transcriptome over the differentiation of embryonic stem cells (ESCs) towards motor neurons. The combinatorial miRNA expression patterns derived by inCell-Biopsy identifies defined cell subpopulations resulted from ESC differentiation, and also reveals the dynamic evolution of cellular heterogeneity. In a MK-801-induced schizophrenia model, we found that astrocytes, instead of neurons, are more heterogeneously affected in the hippocampus of rats underwent repeated injection of MK-801, showing an expression fingerprint related to differentially down-regulated miRNA-135a and miRNA-143; the associated astrocyte subpopulation is also more spatially dispersed in the hippocampus, suggesting an astrocyte dysregulation in the induced schizophrenia animals.

Jacque IP

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Dr. IP Pak Kan Jacque obtained his B.Sc. in Biochemistry from the University of Sydney with first class honours and university medal, and then received his Ph.D. in Biochemistry at The Hong Kong University of Science and Technology. Prof. Ip received further post-doctoral training at the Picower Institute for Learning and Memory, Massachusetts Institute of Technology (MIT). He received a number of awards including the the International Brain Research Organization (IBRO) Rita Levi-Montalcini Research fellowship,Human Frontier Science Program (HFSP) Long-Term fellowship, CUHK Faculty Innovation Award, and RGC Early Career Award. His work has been published in a number of peer-reviewed journals including Science, Nature Neuroscience, Nature Review Neuroscience, Molecular Psychiatry, and the Journal of Neuroscience. Dr. Ip has devoted his research to investigate the mechanisms of synaptic plasticity, and will continue to expand his research focus on how such mechanistic defects result in cardiovascular disease (CVD)-related cognitive impairment through the use of multidisciplinary approaches. His long-term goal is to apply multidisciplinary cutting-edge neurotechnology to probe brain function in health and disease.

Multidisciplinary Approaches To Investigate Cognitive Impairment in CVD

Neuronal circuits in our brain are known to be plastic and are subject to experience-driven changes causing neurons to modify their structure, and functional connectivity and responses. Synaptic plasticity refers to the ability of the neuron to reorganize its synaptic connections and functions in response to alterations in sensory experience or learning. It is established that various cardiovascular disease (CVD) would impair cognitive function such as learning and memory. However, it remains unclear how CVD leads to cognitive deficits. Our group aims to apply different cutting-edge optical imaging methods combined with molecular approaches to dissect the underlying mechanisms and seek novel treatment strategies.

David Clifton

Research Fellow of RAE, OCC Fellow in AI & ML,
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Professor David Clifton is Professor of Clinical Machine Learning and leads the Computational Health Informatics (CHI) Lab. He is OCC Fellow in AI & ML at Reuben College, a Research Fellow of the Royal Academy of Engineering, Visiting Chair in AI for Health at the University of Manchester, and a Fellow of Fudan University, China. He studied Information Engineering at Oxford's Department of Engineering Science, supervised by Professor Lionel Tarassenko CBE. His research focuses on 'AI for healthcare'.

In 2018, the CHI Lab opened its second site, in Suzhou (China), with support from the Chinese government. In 2019, the Wellcome Trust's first "Flagship Centre" was announced, which joins CHI Lab to the Oxford University Clinical Research Unit in Vietnam, focused on AI for healthcare in resource-constrained settings.

He is a Grand Challenge awardee from the UK Engineering and Physical Sciences Research Council, which is an EPSRC Fellowship that provides long-term strategic support for nine "future leaders in healthcare." He was joint winner of the inaugural "Vice-Chancellor's Innovation Prize", which identifies the best interdisciplinary research across the entirety of the University of Oxford.

ML for Pandemics

As healthcare data are acquired in ever-growing quantities, new classes of AI algorithm are required to help humans understand and model these complex datasets to address the urgent demands of medicine during pandemics such as the recent COVID-19. Datasets can include recordings from millions of patients, whereby it becomes necessary to adopt new approaches to modelling. This seminar will introduce new developments in the rapidly-growing field of (non-imaging) "Clinical AI", demonstrating how data scientists can benefit from having "AI to help train the AI"; that is, machine learning networks involved in the construction of new machine learning networks. It will demonstrate successful projects that have been translated into healthcare practice for the COVID-19 pandemic, and highlight on-going international developments in the field, with examples from collaborative work at the Hong Kong Centre for Cerebro-cardiovascular Engineering.

Tingting Zhu

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Tingting Zhu is a Royal Academy of Engineering Research Fellow (equivalent to Assistant Professor) and Member of Faculty in the Department of Engineering Science. She is a Fellow of St. Hilda's College, Oxford and a Lecturer at Mansfield College, Oxford.

She graduated with the DPhil degree in information and biomedical engineering within the Institute of Biomedical Engineering at Oxford University, following degrees in Biomedical Engineering and Electrical Engineering. Her research interests lie in machine learning for healthcare applications and she has developed probabilistic techniques for reasoning about time-series medical data. Her work involves the development of machine learning for understanding complex patient data, with an emphasis on Bayesian inference, deep learning, and applications involving low-income countries.

AI for Time-series Patient monitoring and Risk Prediction

The recent availability of Electronic Health Records and information collected from wearables allows for the development of monitoring and predicting patient risk of deterioration and trajectory evolution. However, prediction of disease progression with the aforementioned patient data is challenging since they are sparse, heterogeneous, multi-dimensional, and multimodal time-series. The talk will describe methods used in artificial intelligence to overcome these challenges.

Yihai Cao

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Yihai Cao is a professor at the Karolinska Institutet, Stockholm, Sweden. He is a member of Chinese Academy of Engineering, Academy of Europe, European Academy of Sciences and Arts, National Academy of Inventors (US), and American Institute of Medicine and Biological Engineering. Yihai Cao received his medical training from the Shandong Medical School and his Ph.D. from the Karolinska Institute. He received his postdoctoral training in Dr. Judah Folkman's laboratory at the Harvard Medical School. Cao's laboratory has focused their interests on studying angiogenesis in tumor growth, metastasis, and non-malignant diseases. Through mechanistic studies, he aims to define novel therapeutic targets and resolve clinically unmet demands of antiangiogenic cancer therapy by proposing new concepts and paradigms. His research interests include molecular mechanisms of pathological angiogenesis contributing to obesity, metabolic diseases, diabetic complications, cancer, metastasis, and cardiovascular diseases, with emphasis on clinical relevance and translational research. He received an honorary medical doctor degree (M.D.) from Copenhagen University, Denmark in 2006. He is a guest professor at the Linköping University, Sweden; a guest professor at the Leicester University, UK; an honorary professor at the Copenhagen University, Denmark; and an honorary professor at the Shinshu University Japan. He received the Fernström research prize, the Axel Hirsch Prize in medicine, and a distinguished professor award at the Karolinska Institutet. Dr. Cao received an ERC-advanced research grant award and the distinguished NOVO Nordisk-advanced grant award. He has published more than 250 research articles. The average impact factor (IF) of his publications > 12.1 per article. His scientific articles have been cited for more than 40 500 times. H-index = 100.

Targeting angiogenesis for disease therapy: Approaching clinical issues of cardiovascular disease

We focus our research on angiogenesis, the process of new blood vessel growth, which is involved in onset and progression of most common human diseases including cardiovascular disease, cancer, obesity, diabetes, and eye disease. Our research programs emphasize translation from basic discovery to clinical implication aiming for development of new concepts and paradigms for disease diagnosis and therapy. In this lecture, I discuss new mechanistic insights into implication of angiogenesis for treating cardiovascular disease with emphasis of establishing functional networks in the ischemic myocardium.

Xiaochuan Pan

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Xiaochuan Pan is a Professor in the Department of Radiology, Department of Radiation & Cellular Oncology, the Committee on Medical Physics, the Comprehensive Cancer Center, and the College at The University of Chicago. His research centers on physics, algorithms, and engineering underpinning tomographic imaging and its biomedical and clinical applications. He has developed close clinical and industrial collaboration and established robust translational programs.

Imaging-Based Intraoperative Assessment of Specimen Tumor Margin in Breast Conserving Surgery

Breast cancer remains a leading cause of a morbidity and mortality among women around the world. It is expected that one eighth of women will develop breast cancer, and >2 million new breast cancers are diagnosed each year globally. The advancement of screening and diagnosis tools allows early treatment of breast cancer, which can lead to better survival outcome and quality of life. Breast conserving surgery (BCS) is used as a part of breast cancer treatment in a majority (~70%) of the cases. In BCS, lumpectomy specimen is removed from the breast. It is hoped that tumor is completely enclosed by healthy tissue in the specimen. It is critically important that the specimen is of negative margin in the sense that the tumor is not close to the specimen surface, because a missed positive margin, i.e., the tumor is too close to the specimen surface, will result in a recall of the patient for re-operation to remove the remaining tumor in the breast. Currently, the recall rate is ~20-30%, and there is a strong need to reduce the recall rate. Imaging tools can be developed for intraoperative, accurate assessment of tumor margins in a specimen. We have developed an imaging solution to this clinical problem. The solution includes a mobile, compact imager that can be placed in the operation room for real-time imaging of specimens, and the associated enabling algorithms/software that allow for rapid scanning, image reconstruction, and image analysis and presentation. In the presentation, I will discuss the solution, along with numerous clinical examples illustrating its clinical efficacy for margin assessment and recall-rate reduction in BCS.

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Nigel Lovell received the B.E. (Hons) and Ph.D. degrees from UNSW Sydney, Australia. He is currently at the Graduate School of Biomedical Engineering UNSW Sydney where he holds a position of Scientia Professor and Head of School. He has authored 300+ journal papers and been awarded over $USD 80 million in R&D and infrastructure funding. Over his career he has mentored 70 PhD students and delivered more than a hundred keynote presentations. He is a Fellow of seven learned academies throughout the world including the IEEE and AIMBE.

His research work has covered areas of expertise ranging from cardiac and retinal modeling, medical informatics and data analytics especially related to telehealth technologies, biological signal processing, and visual prosthesis design. For 2017 and 2018 he was the President of the world’s largest biomedical engineering society – the IEEE Engineering in Medicine and Biology Society.

Biomedical Engineering Advances in COVID-19 Times

As a response to the increasing burden of chronic disease and the ageing population on health care expenditure, considerable focus has been placed on appropriate technologies for promoting self-care and for supporting ageing-in-place. Such technologies are even more critical in the face of emerging health threats such as the COVID-19 pandemic. More so, the impact of COVID-19 has heralded and, in many cases, necessitated the development and introduction of remote monitoring, diagnostics and therapeutics.

A number of medical device technologies aimed at relieving the burden of disease and improving quality of life will be explored. These devices, developed at the Graduate School of Biomedical Engineering (GSBmE), UNSW over the past two decades include telehealth monitoring and decision support systems for chronic disease management; wearable ambulatory technologies based around triaxial accelerometry for estimating risks of falling and for automatically detecting falls; and a range of neural interface technologies for restoring and potentially augmenting sensory loss. The talk will also highlight the future of implantable, wearable and telehealth technologies in future models of patient care and health service delivery especially in the current global pandemic.

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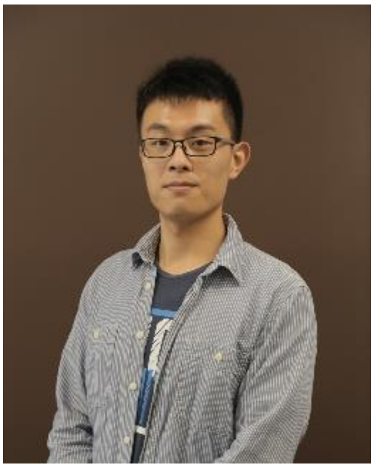

In vivo Fast Two-Photon Volumetric Imaging for CVD Research

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Multiplex high-precision circulating biomarker detection for early prediction of cardiovascular disease enabled by DMD-Based stimulated raman scattering spectroscopy

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High-throughput three-dimensional optical imaging of brain neurons and vessels at the sub-micron level

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Bioinspired flexible flow sensors for flow field perception

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Microfluidic models for personalised medicine

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AIE fluorescent materials and their applications in phototheranostics

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In Silico Clinical Trials: the BVS paradigm

Digital revolution has extended the frontiers of medical devices design and development, with In Silico Clinical Trials (ISCT) being an innovative approach for intuitively, precisely, and reproducibly merging computational tools and biology. Over the last years, a huge investment in *in silico* approaches through the incorporation of patient-specific computer models, accounting on the comprehensive biological and biomedical knowledge and advanced modelling paradigms, has been made. Those *in silico* models can mimic the complexity of human disease mechanisms, address the individual variability and provide predictions on the device's performance. With ISCT, "what if" scenarios and experimental manipulations, currently impossible to being conducted in real-life can be created, complementing the *in vivo* and *in vitro* testing. The application of ISCT in BVS design, development and optimisation is a promising paradigm of how the complexity of human disease and device mechanisms and the individual variability can be mimicked, and contribute to the acceleration of BVS design and development pipeline, serving, in parallel, the principles of the 3Rs (Replacement, Reduction and Refinement) of animal and clinical research.

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Paolo Bonato, Ph.D., serves as Director of the Motion Analysis Laboratory at Spaulding Rehabilitation Hospital, Boston MA. He is an Associate Professor in the Department of Physical Medicine and Rehabilitation at Harvard Medical School, an Adjunct Professor of Biomedical Engineering at the MGH Institute of Health Professions, an Associate Faculty Member at the Wyss Institute for Biologically Inspired Engineering, and an Adjunct Associate Professor at Boston University College of Health & Rehabilitation Sciences. He has held Adjunct Faculty positions at MIT, the University of Ireland Galway, and the University of Melbourne. His research work is focused on the development of rehabilitation technologies with special emphasis on wearable technology and robotics. Dr. Bonato served as the Founding Editor-in-Chief of Journal on NeuroEngineering and Rehabilitation and currently serves as Founding Editor-in-Chief of the IEEE Open Journal of Engineering in Medicine and Biology. He received the M.S. degree in electrical engineering from Politecnico di Torino, Turin, Italy in 1989 and the Ph.D. degree in biomedical engineering from Universita` di Roma "La Sapienza" in 1995.

Using Mobile Health Technology to Inform the Clinical Management of Patients with Neurological Conditions

This lecture will review recent advances in the application of wearable and mhealth technologies to the clinical management of patients with neurological conditions such as Parkinson's disease, stroke, and traumatic brain injury. We will show how relying on wearable and mhealth technologies as well as on machine learning-based algorithms, researchers have developed approaches suitable to derive accurate estimates of clinical scores from sensor data collected during the performance of functional movements. Examples provided during the lecture will include techniques to derive the severity of symptoms in patients with Parkinson's disease as well as motor impairments and functional limitations in stroke and traumatic brain injury survivors. Furthermore, we will discuss how wearable and mhealth technologies can be used to collect kinematic and EMG data and derive data about the motor primitives underlying the generation of movement patterns thus improving our ability to assess motor learning. Finally, we will discuss how these technologies can transform the way clinical interventions are designed and implemented as they enable tracking individual responses to the prescribed therapy.